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15. Supplementary Notes

16. Abstract (Limit: 200 words)

This serial report contains news items, abstracts and articles of scientific reports on all aspects of the Soviet space program, including manned-mission highlights, space sciences, interplanetary research, space biology and medicine, space engineering, applications (satellite geodesy, meteorology, communications, remote sensing) and space science policy and administration.

17. Document Analysis a. Descriptors

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b. Identifiers/Open-Ended Terms

c. COSATI Field/Group   03, 22, 17A, 17B, 17C, 17E, 17G, 17H, 17I

USSR REPORT

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SURPLUS RADIATION ACCORDING TO DATA FROM AN EXPERIMENT WITH THE 'COSMOS-721' ARTIFICIAL EARTH SATELLITE

KUZNETSOV, S. N., RYUMIN, S. P., and TREBUKHOVSKAYA, G. A., Moscow State University
and Institute of Nuclear Physics

[Abstract] The "Cosmos-721" satellite, which was launched on 26 March 1975 into
a polar orbit with an apogee of 240 km and a perigee of 210 km, was equipped with
a gas-discharge counter that was used in an experiment for the purpose of gathering
data on the surplus radiation flow encountered outside the earth's radiation
belts. The results of the measurements indicate that (at the equator, at least)
the basic part of the surplus radiation is composed of electrons with $E_c > 15$ MeV,
the energy spectra and angular, latitudinal and longitudinal relationships which
need to be studied in more detail. Although the surplus radiation flows at al-
titutes of 210-240 km are basically determined by albedo particles, the role
played by quasi-captured particles is also significant (no less than 30-40% of
all the surplus radiation). Figures 6; references 15: 12 Russian, 3 Western.
[7-11746]

RADIATION MEASUREMENTS WITH THE 'COSMOS-900' SATELLITE: 1. SPECTROMETRY OF ELECTRONS

GERBERG, A. N., DRONOV, A. V., ISKANDEROV, A. Sh., PANASYUK, M. I., PETROVA, V. I.,
SOSNOVETS, E. N., RUBINSHTEYN, I. A. and SHCHEBIOT, Yu. V.

[Abstract] A description is given of the equipment and operating principle of
the MES-A and MES-B differential electron spectrometers installed in the "Cosmos-900"
satellite. These spectrometers were developed at the Moscow State University
Sciencific Research Institute of Nuclear Physics for the purpose of studying
streams of electrons with energy from approximately 30 to 1600 keV. These spectro-
meters utilize semiconductor silicon diffusion-drift detectors installed in magnetic

deflection systems with an angle of inclination of 180°. Electrons striking the collimator are deflected by the magnetic field by an angle of 180° and are recorded by a detector. The DDS-12,6/0,5 detector together with the electronics has an electron energy resolution of about 9 keV and the thickness of this detector was selected so that electrons with energies of up to 300 keV would be completely absorbed in the sensitive region. This thickness equaled 500 microns. The angular aperture of the MES-A spectrometer equaled approximately 15°. The DDS-12,6/0,5 detector was used for the purpose of recording electrons with energy within the range of $30 \leq E_e \leq 210$ keV. For registering electrons in the energy range of $94 \leq E_e \leq 1610$ keV was used a set of DDS-5/2-A silicon semiconductor diffusion-drift detectors 5 mm in diameter with a working region thickness of 2 mm. The set of five detectors was installed in the magnetic deflection system of the MES-B. With a 13-mm gap between the magnets the strength of the homogeneous magnetic field equaled about 2700 Gs. The pole tips in both the MES-A and MES-B were made of alloy KS-37, which is an alloy of cobalt and rare earth elements. The angular aperture of the MES-B spectrometer equaled 21°. Specially developed operational amplifiers were used for the purpose of preliminary and final amplification in the electronics section. Optimal pulse shaping was employed for the purpose of improving the signal-to-noise ratio and thereby the unit's energy resolution. The channels of the spectrometers were calibrated by means of ^{109}Cd and ^{57}Co electron and gamma sources and a G5-53 pulse generator. The results are given of a determination of the effectiveness of the registration of electrons in the magnetic deflection systems. The "Cosmos-900" satellite was launched on 30 Mar 1977 into a normal circular polar orbit with a 523-km apogee and 460-km perigee and an inclination of 83° and a 94.4' cycle of rotation. The satellite was steadily oriented with one axis toward the center of Earth and the other along the velocity vector. Examples are given of differential energy spectra of electrons measured by means of the MES-A and MES-B spectrometers. The data were obtained during the period of a calm geomagnetic situation on 7 June 1977 in the morning sector of the magnetosphere. Figures 3; references 5: 2 Russian, 3 Western.
[360-8831]

RADIATION MEASUREMENTS WITH THE 'COSMOS-900' ARTIFICIAL EARTH SATELLITE:
2. SPECTROMETRY OF MEDIUM-ENERGY PROTONS

KOVTYUKH, A. S., MASLOV, V. D., PANASYUK, M. I., REYZMAN, S. Ya. and SOSNOVETS, E. N.

[Abstract] A description is given of the experiment and the preliminary results of measurements made by means of the "Cosmos-900" artificial earth satellite, of streams of protons with an energy greater than 30 keV in the radiation zones of the earth. Differential proton spectrometers developed at the Moscow State University Scientific Research Institute of Nuclear Physics were used to measure streams of protons in the energy range of 30 to 500 keV. Protons were recorded by means of silicon surface-barrier semiconductor detectors which had a thickness in the

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sensitive region of 50 to 100 microns. The aperture of the detectors was approximately 18°. A magnetic filter was placed in front of the detector for the purpose of cutting off electrons with an energy less than 500 keV. The differential spectrum of protons was measured in the differential proton spectrometers by means of a six-channel amplitude analyzer with a resolution of approximately 15 keV. The instruments used included SBT-18 and STS-5 gas-discharge counters, the first of which recorded electrons with an energy greater than 50 keV. The combination of instruments made it possible to record streams of protons over a wide energy range and in two mutually perpendicular directions: in the direction along the magnetic lines of force toward the earth and in the direction perpendicular to the lines of force in the region of invariant latitudes greater than approximately 35°. Differential spectra of protons are presented, obtained by means of the "Cosmos-900" in the southern hemisphere in the morning sector (MLT $\simeq$ 0300 to 0500 h) in a magnetically calm period of long duration and during a period of magnetic disturbances. A comparative analysis is made of the differential spectra of protons obtained in these two periods. In the $L \simeq 3$ to 5 region the differential spectra of protons have a maximum with an energy of $E_p \simeq 100$ to 300 keV. During the magnetically calm period the values of $E_{max}(L)$ are higher than during the period of magnetic disturbances. As L is lowered, this difference increases and reaches its highest value at L = 4 and is then reduced with a further lowering of L. The positions of $E_{max}(L)$ agree during both periods at $L \simeq 3$, i.e., in the depths of the plasmosphere. It is believed that the increase in values of $E_{max}(L)$ with lowering of L is related to the increase in the density of cold plasma and of neutral atoms with lowering of L. Figures 1; references 7: 2 Russian, 5 Western.
[360-8831]

UDC 551.521.8

RADIATION MEASUREMENTS WITH 'COSMOS-900' ARTIFICIAL EARTH SATELLITE. 3. SPECTROMETRIC MEASUREMENTS OF PROTONS AND α-PARTICLES WITH ENERGIES >1 MeV/NUCLEON

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 4, 1980 pp 567-571

IVANOVA, T. A., MASLOV, V. D., PANASYUK, M. I. and SOSNOVETS, E. N.

[Abstract] The principal purpose of the NS-1 instrument carried aboard the "Cosmos-900" artificial earth satellite was the measurement of protons and α-particles with energies >1 MeV/nucleon in several energy ranges while observing solar cosmic rays penetrating during solar flares into the auroral and polar regions of the earth's magnetosphere. The NS-1 spectrometer included two semiconductor detectors of different types, both enclosed in a plastic scintillator (anticoincidence hood) and having an optical contact with the photocathode of an FEU-85 photomultiplier. The semiconductor detectors were calibrated using radioactive sources of α-radiation (Am^{242}). Information on the detectors, the electric thresholds and the energy intervals of the registered particles is summarized in a table. The article gives the preliminary experimental results obtained during the penetration of protons and α-particles into the polar caps of the magnetosphere during the solar flare of 19-22 September 1977. In the case considered the difference

in the N_α / N_p values is evidence of a difference of the differential energy
spectrum of α-particles from the proton energy spectrum in the energy region
> 1 MeV/nucleon. In order to explain the observed change in N_α / N_p in relation
to energy, it is necessary to assume a hardening of the spectrum of α-particles
in comparison with the proton spectrum at energies of several MeV. Figures 2,
tables 2; references 7: 1 Russian, 6 Western.
[13-5303]

EXPERIMENTAL INVESTIGATION OF THE FLOW OF INFRARED ATMOSPHERIC RADIATION BY A
'METEOR' SATELLITE

SOCHNEV, V. G., and TULINOV, V. F.

[Abstract] From 30 June 1977 to 13 June 1978, a two-channel, oblique-sounding
scanning radiometer on board a "Meteor" satellite was used to study the intensity
of infrared radiation in the upper atmosphere. During this period, which was
at the beginning of the initial intensification phase in the 11-year solar activity
cycle, the average Wolf number was about 97 and the geomagnetic index of the geo-
magnetic perturbations reached 7+. The authors examine and compare data on two
instances of increased infrared radiation intensity that occurred on 29 July and
22 September 1977, and then discuss the general import of the measurements that
were made. Figures 2; references 8: 6 Russian, 2 Western.
[317-11746]

INVESTIGATION OF VARIATIONS OF CONCENTRATIONS OF O^+ AND N^+ IONS, DYNAMICS OF THE
IONOSPHERE AND STREAMS OF ENERGETIC ELECTRONS IN THE OUTER IONOSPHERE OF EARTH
BY MEANS OF THE 'METEOR' ARTIFICIAL EARTH SATELLITE: I. MEASUREMENTS IN THE
MIDDLE-LATITUDE IONOSPHERE

IVANOV, G. V., PERKOV, I. A., POGULYAYEVSKIY, L. I., ROMANOVSKIY, Yu. A., RYLOV,
Yu. P. and YAICHNIKOV, A. P.

[Abstract] The results are given of an experiment conducted with a "Meteor"-
series satellite in 1976-1977 utilizing modified mass spectrometer equipment in
order to make a study of relationships between the distribution of ionization in
the outer ionosphere, on the one hand, and large-scale drift movements of ions
and spills of energetic electrons, on the other. The ultimate goal of the study
is knowledge of variations of the ionic composition of the outer ionosphere for

the purpose of developing an empirical model of it, as well as the identification of ionosphere-magnetosphere relationships and their role in the formation of the earth's ionosphere. Measurements were made of   ion composition and of large-scale drifts of the ionospheric plasma, as well as of integral electron streams with energy greater than 350 eV, whereby measurements of drift were utilized for estimating electric fields in the outer ionosphere. The satellite's orbit maintains a nearly steady altitude near the boundary of the ionosphere, i.e., 850 to 900 km. Measurements were made of the concentration of O^+ and N^+ ions and of large-scale drifts of O^+ ions at the minimum of the 21st cycle of solar activity. Results are given of measurements in the middle-latitute ionosphere. The "Meteor" satellite was launched on 15 May 1976 into orbit with a 920-km apogee and 845-km perigee and an inclination of 81^0. As the satellite traveled in its orbit, two geophysical parameters varied considerably, i.e., the altitude and the zenith angle of the sun. The great inclination of the satellite's orbit made it possible to make measurements in the auroral zones and at the polar caps. Most of the data was obtained in two longitude zones, 0 to 80^0 longitude east and 100 to 170^0 longitude west. The mass spectrometer unit was a two-channel modified radio-frequency mass spectrometer of the Bennet MKh-6407 type. This instrument measured currents of H^+, N^+ and O^+ ions. Measurements of the concentration of H^+ ions proved to be unreliable and are not discussed here. The concentrations of ions were estimated from measured ion currents by utilizing the data of laboratory calibration of mass analyzers employing an NH_3^+ ion beam. Measurements were made of the velocity component of the drift perpendicular to the plane of the orbit for the purpose of studying large-scale drift movements. The unit's two mass analyzers were employed as follows: Mass analyzer A2 was oriented along the satellite's velocity vector and was intended to measure ion concentrations, whereas analyzer A1 was placed at a 90^0 angle to the velocity vector in the plane parallel to the surface of Earth and was intended to measure the component of the drift of O^+ ions perpendicular to the plane of the orbit. The geometrical aperture of analyzer A2 equaled 8^0 and of A1 14^0. Data were obtained on seasonal and diurnal variations of ions and asymmetry of the hemispheres was detected with respect to amplitudes of diurnal and seasonal variations of $n[O^+]$. The amplitude of the diurnal variation of $n[O^+]$ in the southern hemisphere near the summer solstice is three to four, chiefly on account of anomalously high concentrations of ions at night. It is suggested that the northern-southern asymmetry, at least at the solar activity minimum, is a rather common phenomenon in the thermosphere and ionosphere of the earth, which ought to be taken into account together with other phenomena and variations in the thermosphere and ionosphere. Figures 4; references 17: 9 Russian, 8 Western.
[360-8831]

PROGNOZ-6 OBSERVATIONS OF X-RAY SOURCES. II. OBSERVATIONS OF SCO X-1, X PER AND THE GALACTIC CENTER

RAKHAMIMOV, Sh. Yu., ESTULIN, I. V., VEDRES, Zh. and NIEL', M., Shemakhinskaya Astrophysical Observatory of the Azerbaijan SSR Academy of Sciences, Institute of Space Research of the USSR Academy of Sciences, Moscow, and the Center for the Study of Space Emissions, Toulouse, France

[Abstract] The X-ray source Sco X-1 was observed with the SNEG-2MP instrument from 21 November to 1 December 1977 in the automated Prognoz-5 station in a joint Soviet and French experiment. The source was observed for three sequential orientations of the station with a pure observation, allowing for the time the station was close to the earth, of about 50 hours. The averaged spectrum of the source is shown graphically and a power law equation approximating the spectrum in a range of 40 to 150 KeV is given. The X-ray source X Per was within the field of view of the instrument from 21 November to 2 December 1977. The radiation was observed in a range of from 27 to 132 KeV and the flux in this range was $7.2 \pm 0.6 \cdot 10^{-9}$ erg/cm$^2 \cdot$ sec during 26 - 27 November, and $9.6 \pm 0.7 \cdot 10^{-9}$ erg/cm$^2 \cdot$ sec from 30 November to 1 December. Regions of the galactic center were observed from 15 November through 25 December 1977; the spectral parameters and corresponding fluxes are presented in tabular form for three specific orientations of the station. Figures 3; references 19: 4 Russian; 15 Western.
[3-8225]

OBSERVING THE INJECTION OF PLASMA FORMATIONS IN THE HIGH-LATITUDE BOUNDARY LAYER OF THE EARTH'S MAGNETOSPHERE

VAYSBERG, O. L., OMEL'CHENKO, A. N., and SMIRNOV, V. N.

[Abstract] The "Prognoz-7" satellite, which was launched on 30 October 1978 into an orbit inclined at an angle of about 80° to the ecliptic plane, carried an equipment complex that was used to study magnetic fields, plasma and highly charged particles in the solar wind and the geomagnetosphere. The authors present the results of measurements of plasma flows in the high-latitude boundary layer of the magnetosphere, discuss them and draw conclusions. Basically, the situation was that isolated and quasiperiodic plasma surges with a characteristic duration of 20-25 minutes were detected on the force lines in the boundary layer. Part of these surges showed a typical change in the flow and particle energy as time passed. The hypothesis is that the appearance of these surges is related to nonstationary diffusion or rejoining at the edge of the Earth's magnetosphere. Figures 4; references 8: 2 Russian, 6 Western.
[317-11746]

SPECTRUM AND VARIABILITY OF SOLAR RADIATION IN THE 3 TO 13 MICRON RANGE ('SALYUT-5')

MARKOV, M. N., VOLYNOV, B. V., ZHOLOBOV, V. M., GORBATKO, V. V., GLAZKOV, Yu. N.,
PETROV, V. S., IVANOV, Yu. S. and DOMBROVSKIY, N. O.

[Abstract] The results are given of studies made by means of the ITS-5 infrared
telescope spectrometer developed at the Physics Institute imeni P. N. Lebedev
for the "Salyut-5" orbital scientific station. The purpose of these studies was
to obtain the extra-atmospheric spectra of the sun in the middle infrared region
and to observe time variations in the intensity of radiation over this entire
region. A determination of both the distribution of energy in the spectra and
of the variability of the total flow of solar infrared radiation is of great
importance for understanding the structure of the solar atmosphere, as well as
the processes for the transmission of energy from the convective zone and the
photosphere to upper layers of the atmosphere, i.e., the thermosphere and corona.
The ITS-5 infrared telescope spectrometer contains a Newtonian main mirror with
a focal length of 45 cm and dimensions of 19 X 24 cm. The spectrometer is of the
Littrow-Pfund type with an NaCl prism and the radiation receiver is a bolometer.
The wavelength band is 1.8 to 15.0 microns and the spectral width of the slit
varies from 0.5 to 0.70 micron. The radiation measured is modulated at a frequency
of 15 Hz. The amplifier has a dynamic range of 10^4 and the 15 Hz amplified signal
is recorded by a magnetic recorder on four channels. The telescope is furnished
with a viewfinder for the purpose of fine adjustments in direction in manual control
of the station, when necessary. The viewfinder serves the purpose also of monitoring
the position of the sun, which is photographed every 2.5 s by means of a motion
picture camera. Observations were made on 1, 4, 5 and 22 August 1976 and
16 February 1977. A study was made of a total of 150 spectra taken with the
position of the sun within the range of zenith angles of 50 to 90^0. Fifty of the
best spectra were selected for analysis. Spectra were obtained over the 3 to
13 micron region with a resolution of two percent. The mean flight altitude of
the "Salyut-5" was 270 to 280 km. With an accuracy of ± 5 percent the mean spectral
variation agrees on the whole with the generalized data of many years of observation
of the sun from the earth through atmospheric transmittance windows. Variability
with intensity of as much as $1.3 \cdot 10^7$ erg·cm^{-2}·s^{-1} was observed in the 4.05 to 5.25
micron region. This represents $2 \cdot 10^{-4}$ of the total flux of the sun. The variation
period equals approximately 24 h. The variability is that of the calm sun and
not of its active regions. The average dimensions of sections from which the
radiation arrived were on the order of 4 X 10' on the solar disk and the temperature
change characteristic of the variability was approximately 300 to 400^0 K. Although
the infrared radiation of the sun is determined by H$^-$ ions and this radiation has
a continuous spectrum, in individual sections there is a component consisting of
separate lines and bands, in particular, a rotational-vibrational CO band with
a maximum of approximately 4.7 microns; this CO band is difficult to observe from
the earth. It is believed that the CO band plays a decisive role in the balance
of energy. This question is discussed in some detail. Figures 4; references 11:
3 Russian, 8 Western.
[360-8831]

CAPACITANCE OF ION SCREEN AROUND CYLINDRICAL LOW-FREQUENCY ANTENNA MOUNTED ON AN ARTIFICIAL EARTH SATELLITE

MODESTOV, A. P.

[Abstract] Ionospheric plasma exerts a substantial effect on the input resistance of a low-frequency electric antenna mounted on a space vehicle in the ionosphere. A contribution to the resulting characteristics of such an antenna is introduced by both the magnetically active plasma around it and by the ion screen which is formed in the immediate neighborhood of the antenna due to the difference in the thermal velocities of electrons and ions. Accordingly, the author has studied a cylindrical antenna situated in collisionless plasma consisting of positive ions and electrons having a Maxwellian velocity distribution. It is assumed that the ion concentration near the surface of the antenna is invariable and equal to the concentration in unperturbed plasma. It is assumed that the antenna is charged negatively, as corresponds to real conditions on an artificial satellite at the considered altitudes. A method is proposed for computing the dynamic capacitance of an inhomogeneous ion screen around the antenna. The dependence of capacitance of the ion screen on antenna potential was determined for an antenna with a length of 5 m and a radius of 1.2 cm for different electron concentrations and also on the electron concentration with a floating potential. The results of computations are compared with measurements at a frequency of 50 KHz carried out in the ionosphere at altitudes 200-1,500 km on the artificial earth satellite "Intercosmos-Kopernik 500." Figures 3; references 13: 7 Russian, 6 Western.
[13-5303]

THE DETERMINATION OF THE ABSOLUTE DECLINATIONS OF EQUATORIAL STARS FROM OBSERVATIONS AT THE EQUATOR USING A TRANSIT INSTRUMENT

NAUMOV, V. A., Main Astronomical Observatory of the USSR Academy of Sciences

[Abstract] A micrometric method for the determination of the absolute declinations of equatorial stars was first proposed by Kreynin and Murri and employed a zenith telescope close to the equator as well as a micrometric transit. The deficiencies of this procedure are related primarily to the use of two instruments: twice the number of observations are required as is the determination of an additional unknown; the graduations of the micrometer screw of the zenith telescope limit the accuracy and the zenith stars must be observed at the moment of their culmination. Two procedures are proposed to circumvent these difficulties, which are based on the use of a single transit instrument and the observation of pairs

of stars in the east and west. The advantages claimed are: the reduction of random errors related to the sighting on a star, the reduction of the effect of instrument azimuth instability errors and most importantly, it is possible to determine the instrument azimuth. The discussion of the procedures is supplemented with the analytical expressions for the observations, though no sample calculations are given to illustrate data reduction. It is noted that the determination of declinations with a precision "on the order of 0"01 for 250 observations" anticipated by Kreynin and Murri for their method is absolutely impossible. References: 9 Russian.
[355-8225]

OVERPRESSURE IN AN AEROSTAT ENVELOPE AND THE POSSIBILITY OF REGULATING IT WHEN FLOATING IN THE ATMOSPHERE OF VENUS

MOSKALENKO, G. M. and TROSHIN, V. S.

[Abstract] A description and discussion are presented of an aerostatic sonde designed for floating in the atmosphere of Venus at any altitude to the maximum and able to both increase and reduce its steady floating altitude according to a preset program by means of a change in the volume of the aerostatic envelope with the sonde's flying weight unchanged. The sonde consists of an envelope with a semi-rigid design which can change its volume by means of lengthwise compression and extension, and of a section for the payload. The envelope is filled with a light gas, e.g., superheated steam. The maximum floating altitude will be determined by the altitude for condensation of the steam, equaling about 36 km. An equation is derived for the mass of the steam to be filled into the envelope. Equations are derived for the change in pressure inside the envelope with a change in the altitude at which the sonde floats. It is assumed that the space occupied by the payload is negligibly small as compared with the volume of the aerostatic envelope. Curves are presented, showing the dependence of the overpressure in the aerostat envelope on the steady floating altitude with no temperature difference and the temperature differential between the steam in the aerostat envelope and the atmospheric gas as a function of the steady floating altitude with no pressure difference. The maximum pressure drop equals 1.32 kg/cm^2 when the sonde floats at an altitude of 10 km. Since this pressure drop is rather considerable, it must be taken into account in the development of a sonde of this type. Figures 3; references 2: 2 Russian.
[360-8831]

RADAR INVESTIGATION OF THE RELIEF AND REFLECTIVE PROPERTIES OF VENUS' SURFACE AT THE 39 cm WAVELENGTH

ALEKSANDROV, Yu. N., GOLOVKOV, V. K., DUBROVIN, V. M. et al., Institute of Radiotechnology and Electronics, USSR Academy of Sciences

[Abstract] The first radar studies of the reflected surface properties of Venus at the 39 cm wavelength were carried out in 1962. In this paper, indices of Venus' altitude profile and of its reflective properties along the radar scan tracts obtained in 1972, 1975 and 1977 were reported. Specifically, the smoothness parameter "C" of Hagfors reflection law, the root mean square inclination angle β

of the surface irregularities, the mirror reflection coefficient ρ and the dielectric permeability ξ were given. The report includes the following subtopics: the relationship of the echo signal parameters to planet-centric coordinates, reflected planet surface properties, and altitude profiles of the Venus surface. The following values were calculated for the region bound by -10 to +10° lattitude and 280-360° longitude: $C = 345 \pm 97$, $\rho = 3.1° \pm 0.4°$, $\rho = 0.144 \pm 0.03$, $\xi = 4.1 \pm 0.9$. These values show considerable variation, depending on the longitude and latitude. Profiles of the altitudes were compared at 6°, -3° and -8° latitude and 290°, 325°, and 355° longitude. The profile at 290° resembled a depression 2 km deep and 200 km wide; the one at 325° suggested a 2 km high mountain. At 350° the profile resembled a gigantic crater. Figures 8, references 30: 18 Russian, 12 Western.
[330-7813]

EXPERIMENT FOR DIAGNOSIS OF INTERPLANETARY AND MAGNETOSPHERIC PLASMA ON THE AUTOMATIC INTERPLANETARY STATIONS 'VENERA-11, 12' AND THE ARTIFICIAL EARTH SATELLITE 'PROGNOZ-7'

VEYSBERG, O. L., GORN, L. S., YERMOLAYEV, Yu. I., ZASTENKER, G. N., ZAKHAROV, D. S., ZERTSALOV, A. A., KLIMASHOV, A. A., LEIN, E. L., LEYBOV, A. V., OMEL'CHENKO, A. N., POMOGAYEV, V. V., ROMANOV, S. A., SMIRNOV, V. N., STEFANOVICH, A. Ye., TEMNYY, V. V., KHAZANOV, B. I. and SHIFRIN, A. V.

[Abstract] The "Venera-11" and Venera-12," as well as the high-apogee "Prognoz-7" satellite, during 1978-1979 were used in an experiment for studying the solar wind and geomagnetosphere. Each of the three vehicles carried identical selecting combined plasma spectrometers. The objective was to continue studying plasma processes initiated earlier with other satellites and stations. The scientific objectives were: to obtain information on the mechanisms of heating and acceleration of the ion components of the solar wind on the basis of measurements of the relationships of the parameters of the proton and α-components of the solar wind and changes in these relationships depending on heliocentric distance; to investigate the velocity of propagation and other characteristics of interplanetary shockwaves on the basis of simultaneous measurements on three vehicles; to study the structure of the region of interaction between the solar wind and the earth's magnetosphere, especially the form and character of motion of the circumterrestrial shock wave in the high-latitude regions as well as plasma streams near the magnetopause; to analyze the mechanisms of dissipation of the energy of ions in circumterrestrial and interplanetary shock waves by using selective measurements of the proton and α-components of the solar wind; to examine features of the distribution functions for the ion and electron components in the solar wind; to measure solar wind characteristics as the American "Pioneer-Venus" passed through the region of interaction between the solar wind and Venus for studying the dynamic processes transpiring in this region. First the authors describe the measurement method and give the characteristics of the plasma spectrometer. The experimental conditions are given in detail. Preliminary results are given with respect to most of the different scientific objectives mentioned above. Figures 13; references 10: 8 Russian, 2 Western.
[34-5303]

VENUSIAN UV RADIATION DETERMINED FROM "VENERA" DATA

KURT, V. G., ROMANOVA, N. N. and SMIRNOV, A. S., USSR Space Research Institute, BERTAUX, J. L. and BLAMONT, J. E.

[Article entitled "Ultraviolet Radiation of Venus in the Region of Wavelengths 300-1657 A According to data from 'Venera-11' and 'Venera-12' (Preliminary Results)"]

[Abstract] Measurements of the scattered UV radiation in the upper atmosphere of Venus were made aboard the fly-by vehicles of the "Venera-11" and "Venera-12" interplanetary stations after separation of the descent modules. Each station carried two identical diffraction spectrometers developed and constructed in accordance with the Soviet-French space exploration cooperative program. The spectrometer was constructed in the Wadsworth scheme with a paralled beam at the input and a concave holographic grating with a curvature radius of 900 mm, 300 rulings/mm and a line dispersion ~ 6.5 A/mm. The grating surface was covered by platinum. Ten identical detectors were mounted in the spectrometer focal plane; each detector registered radiation in a band with a width ~ 12 A. The two stations flew by Venus on the sunward side; the flight trajectory intersected the plane of the ecliptic and therefore intersected the equatorial plane of Venus at an angle $\sim 45^\circ$. The parameters of the fly-by trajectories are summarized in Table 1. Samples of measurements made in observations near the planet are shown in Fig. 2. In the analysis made here use was made only of data for the channels measuring intensity in the hydrogen line L_α λ 1216 A and the helium line λ 584 A. The article gives theoretical and experimental values for the observed intensity of L_α radiation and the parameters of helium distribution in the Venus an atmosphere. Figures 5, tables 1; references 8: 1 Russian, 7 Western. [34-5303]

CHEMICAL COMPOSITION OF THE VENUSIAN TROPOSPHERE AND CLOUD LAYER ON THE BASIS OF MEASUREMENTS MADE BY 'VENERA-11,' 'VENERA-12' AND 'PIONEER-VENUS'

KRASNOPOL'SKIY, V. A. and PARSHEV, V. A.

[Abstract] A series of experiments with the descent modules of the "Venera-11" and "Venera-12" interplenatary stations was carried out to ascertain the chemical composition of the Venusian troposphere and cloud cover; this also involved measurements by "Pioneer-Venus." A summary of the published results is given in Table 1. The table includes measurements made with a mass spectrometer, gas chromatograph and optical spectrometer on the "Venera-11" and "Venera-12" and a gas chromatograph and three mass spectrometers on the "Pioneer-Venus." The objective of the study was to analyze atmospheric components actively participating in chemical processes. Since thermochemical equilibrium processes are very important, these are analyzed in considerable detail. Discrepancies in data

obtained in different experiments are pointed out and an effort is made to resolve the contradictions between different calculations. The authors considered, but rejected, the possibility that these discrepancies are attributable to real variations in the Venusian atmosphere. Particular attention is given to sulfur and chlorine compounds. The composition of the Venusian lower atmosphere under conditions of thermochemical equilibrium at present appears to be:

Gas	"Venera-11, 12"	"Pioneer-Venus"
CO_2	0.96	0.96
SO_2	1.5-4	1.5-4
O_2	---	7-5
CO	1.5-5	---
S_2	1-7	---
SO_3	---	1.3-3
COS	2-5	---
CS_2	---	---
H_2O	3-5	1.35-3
H_2	3-9	---
H_2S	5-8	---
N_2	3.4-2	3.4-2
NO	---	3-9
NO_2	---	3-10
NH_3	---	---
HCl	1-6	1-6
Cl_2	---	2.5-10
HF	1.8	1.8

Note: The table gives the relative contents of the components f_i; values $f_i < 10^{-10}$ are not indicated; 1.5-4 means $1.5 \cdot 10^{-4}$. Figures 1, tables 2; references 37: 10 Russian, 27 Western.
[34-5303]

LIGHTNING IN VENUSIAN CLOUD LAYER

KSANFOMALITI, L. V.

[Abstract] In an experiment aboard the "Venera-11" and "Venera-12" vehicles for the first time there was detection of low-frequency radioemission of the Venusian atmosphere and it was established that there are frequent electric discharges in the atmosphere (frequency 30 sec^{-1} or more in one source). The energy in the discharges is evidently close to the energies in terrestrial lightning and the discharges occur in the cloud layer. During the experiment the thunderstorm phenomena had a local character. One of the active regions extended ~150 km. The thunderstorm activity on Venus was greater than on the earth. It is entirely adequate for the formation of many small components of the planetary atmosphere. With an intensification of Venusian thunderstorm activity by several

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times in comparison with that registered on the "Venera-11" the glow on the night-
time side of Venus caused by lightning could be observed from the earth. At-
mospheric electric discharges are characteristic not only of the earth, but also
other planets with adequately dense gas envelopes. They occur on Venus, the
Earth and Jupiter, and also probably on other giant planets. Figures 9; references
23: 15 Russian; 8 Western.
[34-5303]

AEROSOL COMPONENT OF THE VENUSIAN ATMOSPHERE ACCORDING TO MEASUREMENT DATA FROM
THE 'VENERA-11' STATION

MAROV, M. Ya., BYVSHEV, B. V., BARANOV, Yu. P. LEBEDEV, V. N., LYSTSEV, V. Ye.,
MAKSIMOV, A. V., MANUYLOV, K. K. and FROLOV, A. M.

[Abstract] The descent module of the "Venera-11" station carried a backscattering
nephelometer, a modernized variant of the backscattering nephelometer carried
aboard "Venera-9" and "Venera-10." The principal differences from the preceding
variants are given. Measurements were made of the backscattering index $_{1800}(h)$
from an altitude of 51 km to the surface in the region of vehicle descent.
The greatest signal intensity was registered beginning at an altitude of 51 km
to an altitude of 48 km. Here the δ_{1800} index attained values $(12-18) \cdot 10^{-5} m^{-1} \cdot sr^{-1}$.
An increased reflection of the medium was also registered in the altitude ranges
17-13 and 12-8 km; in the remaining regions the signal was below the instrument
response threshold. The δ_{1800} values characterize the local reflectivity of
the aerosols present in the atmosphere. Figure 1 in the text is an optical
diagram of the nephelometer. The registered reflection in the altitude range
51-47.5 km corresponds to cloud layer III in the classification adopted on the
basis of data from "Venera-9" and "Venera-10." It has a vertical extent of
about 3 km. The optical density of this layer was several times greater than
its density in the region of "Venera-10" descent. The subcloud atmosphere in
general is quite transparent. Figures 2; references 7: 2 Russian, 5 Western.
[34-5303]

SPECTROPHOTOMETRIC EXPERIMENT ON THE DESCENT MODULES OF THE 'VENERA-11' AND
'VENERA-12.' 1. METHOD, RESULTS AND PRELIMINARY ANALYSIS OF MEASUREMENTS

EKONOMOV, A. P., MOSHKIN, B. Ye., GOLOVIN, Yu. M., PARFENT'YEV, N. A. and
SAN'KO, N. F.

[Abstract] The descent modules of the "Venera-11" and Venera-12" interplanetary
stations carried identical instruments, IOAV scanning spectrophotometers, for
investigating the spectral composition and spatial distribution of scattered
solar radiation in the Venusian atmosphere from an altitude ~65 km to the planetary

surface. The IOAV carries out continuous scanning in the spectrum in the visible and near-IR regions (0.43-1.117 μm) as well as circular scanning in space in a plane close to vertical, registering radiation in four broad spectral ranges. The objectives of the experiment were: to examine the spectral composition of scattered solar radiation for making a quantitative estimate of the atmospheric content of substances having strong absorption bands, such as water; to study the vertical structure of the atmosphere and horizontal inhomogeneity of the cloud layer; to determine the energy balance of the Venusian atmosphere. The initial results of this experiment have already been published (Yu. M. Golovin, et al., PIS'MA V ASTRON. ZH., 5, No 1, 4, 1979; V. I. Moroz, et al., PIS'MA V ASTRON. ZH., 5, No 5, 222, 1979). This new paper gives a more detailed description of the method and measurement data, accompanied by preliminary analysis. A more detailed interpretation, by the addition of layers method, is given in another paper in this issue of the journal (pp 727-742). Figures 8, tables 2; references 26: 21 Russian, 5 Western.
[34-5303]

SPECTROPHOTOMETRIC EXPERIMENT ON THE DESCENT MODULES OF 'VENERA-11' AND 'VENERA-12'
2. ANALYSIS OF SPECTRAL DATA FROM 'VENERA-11' BY THE 'ADDITION OF LAYERS' METHOD

MOROZ, V. I., PARFENT'VEV, N. A. and SAN'KO, N. F.

[Abstract] An earlier paper (A. P. Ekonomov, et al., PIS'MA V ASTRON. ZH., 5, No 5, 222, 1979) gave preliminary results of analysis of the spectrum of the daytime sky of Venus obtained directly from the planetary surface. In another article in the same number of this journal (pp 714-726) a more detailed description was given of the instrumentation and methods employed and preliminary measurement results. This paper expands on this information, reflecting further interpretation and analysis of the results. Figure 1 shows several (from a total of about 300) spectra obtained by the "Venera-11" during the parachute descent from 62 km to the surface. The spectra give the values
$$I_\downarrow (\lambda, h) = \pi J(\lambda, h)/\cos z \cdot E_0(\lambda).$$
Here $J(\lambda)$ is the intensity of scattered radiation at the zenith at the altitude h, λ is wavelength, z is solar zenith distance at the landing point, $E_0(\lambda)$ is the monochromatic illumination of an area situated outside the atmosphere in the orbit of Venus. The $I_\downarrow (\lambda, h)$ parameter has the same sense as the brightness coefficient for radiation emanating from the atmosphere or transmitted by it. The paper examines the following: 1) a method for numerical modeling used in this paper; 2) the results of numerical modeling of $I_\downarrow (\lambda, h)$ profiles in the continuous spectrum; 3) the results of calculating the H_2O content at various altitudes, based on an analysis of the spectrum in the region of the absorption bands. In this modeling the authors make use of the "addition of layers" method proposed by A. A. Lacis, et al. (J. ATMOS. SCI., 31, 118, 1974). In this method the scattering medium is broken down into the necessary number of layers; the choice of the number of layers in the model is determined by the nature of the vertical profile of its parameters (within the limits of each layer the change in parameters must not be very great). A model with 20 layers was used in this

study; the region of altitudes was from 0 to 70 km and the vertical interval was variable. Full data from modeling of the $I\downarrow(\lambda, h)$ profiles are given, followed by a determination of the abundance of water vapor and its vertical distribution. Among the interesting conclusions drawn is that the H_2O content at the surface is an order of magnitude less than in the cloud layer. Figures 12, tables 2; references 27: 19 Russian, 8 Western.
[34-5303]

ANALYSIS OF THE CHEMICAL COMPOSITION OF THE VENUSIAN ATMOSPHERE ON THE 'VENERA-12' AUTOMATIC INTERPLANETARY STATION BY A GAS CHROMATOGRAPH

GEL'MAN, B. G., ZOLOTUKHIN, V. G., LAMONOV, N. I., LEVCHUK, B. V., LIPATOV, A. N., MUKHIN, L. M., NENAROKOV, D. F., ROTIN, V. A., and OKHOTNIKOV, B. P.

[Abstract] The descent modules of the "Venera-11" and "Venera-12" automatic interplanetary stations carried "Sigma" gas chromatographs for analysis of the chemical composition of the Venusian atmosphere. A distinguishing characteristic of the "Sigma" chromatograph is the use of a highly sensitive ionization detector based on use of the Penning effect in rare gases. A block diagram of the "Sigma" is reproduced in the text. The chromatograph consists of three individual parts: a unit for taking samples, an analyzer and an electronics unit, including power source and memory. The main analytical part of the "Sigma" is the analyzer. A cylinder with a carrier-gas stores neon at a pressure of 300 kg/cm^2 in a quantity adequate for instrument operation for a period of six months. Analysis of the gas sample and calibration mixture is accomplished in three successively arranged columns and detectors. Each of the operations involved in the chromatograph work program is described. A total of 54 chromatograms were obtained, of which 18 corresponded to the readings of the first detector (determination of sulfur compounds and H_2O) and 27 corresponded to an analysis of constant gases. Data on the results of the chromatographic analysis in analog form were transmitted through telemetry channels and simultaneously the chromatograms of the first three analytical cycles were recorded in the instrument memory. The data indicate that the oxygen concentration in the Venusian atmosphere is at least less than $2\cdot10^{-3}\%$ by volume. The atmospheric composition is given below.

Gas	Concentration, % by volume
N_2	2.5 ± 0.3
Ar	$(4\pm1.0)\cdot10^{-3}$
CO	$(2.8\pm0.7)\cdot10^{-3}$
SO_2	$(1.3\pm0.35)\cdot10^{-2}$
H_2O	$5\cdot10^{-3}\ ^{+100\%}_{-50\%}$
O_2	$< 2\cdot10^{-3}$

Figures 3, tables 1; references: 4 Russian.
[34-5303]

COMPOSITION OF THE LOWER VENUSIAN ATMOSPHERE USING MASS-SPECTROMETER DATA

ISTOMIN, V. G., GRECHNEV, K. V., KOCHNEV, V. A. and OZEROV, L. N.

[Abstract] The mass spectrometers on the "Venera-11" and "Venera-12" descent modules took the first sample of the Venusian atmosphere at an altitude of about 23 km and continued to function down to the landing. The last gas samples were taken at an altitude of about 1 km above the planetary surface. Each of the descent modules took 11 gas samples and a total of 176 mass spectra were transmitted to the earth; these characterized the chemical and isotopic composition of the lower atmosphere. The mass spectra were transmitted and recorded in analog form. It was found that the isotopic composition of the principal atmospheric components, that is, carbon, oxygen and nitrogen, is close to the earth's. The principal admixture in the Venusian atmosphere is nitrogen. Its concentration is approximately $4.5 \pm 0.5\%$. The concentration of all other admixtures in the Venusian atmosphere, both chemically active and inert gases and vapors, fall below the level of several hundredths of a percent by volume. The content of inert gases in the Venusian atmosphere was measured for the first time. The mass spectrometer registered three argon isotopes (36, 38 and 40 amu), neon (20 amu) and krypton (84 amu). The total content of the argon isotope is estimated at 150 ± 50 ppm. The content of the neon isotope (^{20}Ne) is from 10 to 15 ppm, and krypton ^{84}Kr -- from 0.5 to 0.8 ppm. It is postulated that the Venusian atmosphere is entirely "primary," owing its origin to gas accretion from the protoplanetary nebula. Figures 3; references 8: 5 Russian, 3 Western.
[34-5303]

MASS SPECTROMETER FOR THE 'VENERA-11' AND 'VENERA-12'

GRECHNEV, K. V., ISTOMIN, V. G., OZEROV, L. N. and KLIMOVITSKIY, V. G.

[Abstract] The MKh6411 mass spectrometer, carried aboard the "Venera-11" and "Venera-12" interplanetary stations, consists of four principal parts: an analytical system, incorporating a radio-frequency analyzer, ion source and magnetic discharge pump; an electrometer rigidly attached to the analyzer base; an admission valve connected to the analytical system by a flexible copper tube; an electronics unit. Figure 1 in the text is a functional diagram of the mass spectrometer which illustrates operation of the main units of the instrument in accordance with the cyclogram shown as Fig. 2. Instrument operation is characterized by measurement cycles, each of which begins with a command arriving from the telemetry system and which ends automatically after total processing. The measurement cycle consists of four stages: 1) search; 2) measurement in a "full chemical analysis" mode; 3) search; 4) measurements in an "analysis of inert components" mode. The step-by-step functioning of the instrument is described in detail with the functional diagram (20 components are identified) and the cyclogram serving as the basis for this description. The instrument operates in the range of mass numbers 11-105 amu, the time required for taking a gas sample is less

than $5 \cdot 10^{-3}$ sec, sensitivity for nitrogen is 0.2%, for neon and methane -- 5 ppm, for argon and krypton -- 1 ppm, emission current is 0.4 mA, ionizing potential is 40 V. The instrument weighs 9.5 kg and the current required is 17 volt-ampere. Figures 3; references: 4 Russian.
[34-5303]

PRELIMINARY RESULTS OF SEARCH FOR GAMMA BURSTS ON THE AUTOMATIC INTERPLANETARY STATIONS 'VENERA-11' AND 'VENERA-12' USING THE 'SNEG-2MZ' INSTRUMENT

ZENCHENKO, V. M., KUZNETSOV, A. V., ESTULIN, I. V., VEDREN, J., NIEL, N. and CARLE, K.

[Abstract] The most precise method for locating a source of a gamma burst when using an omnidirectional detector of gamma radiation is based on measurement of the lag time for arrival of events at different space vehicles. This method was used in this study involving the search for gamma bursts made using the "Venera-11" and "Venera-12" interplanetary stations, both of which were outfitted with the "SNEG-2MZ" instrument. In such investigations the angular resolution is directly dependent on distance between the space vehicles. Therefore, the use of the "Venera" vehicles in the search for gamma bursts afforded exceptionally advantageous conditions because the distance between them was 2-10 million kilometers, whereas the distance to an earth satellite attains 20-100 million km. This ensured a high angular resolution of about 2-20'. The search in the Soviet-French "SNEG-2MZ" experiment was carried out beginning on 10 September 1978 on the flight trajectory to the planet and after implementation of the program with the descent modules. The automatic station "Prognoz-7" was put into a high-apogee earth orbit on 31 October 1978; it carried the "SNEG-2MP" instrument. From that time the program was carried out using three spacecraft situated at considerable distances from one another and all had identical burst detection instruments. These instruments had two identical omnidirectional gamma radiation detectors, one of which is mounted on the solar side of the vehicle and the other on the antisolar side. Each detector consists of an NaI(Tl) spectrometer crystal with a diameter of 90 mm and a height of 37 mm, packed in a plastic scintillator with a thickness of 8 mm for excluding pulses from charged particles. The bursts of cosmic radiation detected in the experiment are described and are listed in Tables 2 and 3. These events, since precise time and ballistics data are available, are suitable for locating the sources of the gamma bursts in the celestial sphere. The authors speculate on the nature of these sources and postulate that they may be objects which do not show up in the optical and radio ranges (for example, "old pulsars"), situated not far from the solar system. Figures 7, tables 5; references 12: 7 Russian, 5 Western.
[34-5303]

STUDY OF COSMIC GAMMA BURSTS IN THE 'KONUS' EXPERIMENT

MAZETS, Ye. P., GOLENETSKIY, S. V., IL'NISKIY, V. N., PANOV, V. N., APTEKAR', R.L., GUR'YAN, Yu. A., SOKOLOV, I. A., SOKOLOVA, Z. Ya. and KHARITONOVA, T. V.

[Abstract] The article describes observations and study of γ-bursts by the "Konus" instrument carried aboard the "Venera-11" and "Venera-12" automatic interplanetary stations. The "Konus" is in a stand-by regime, during which there is periodic measurement of the intensity and spectrum of the cosmic background in each of the six scintillation counters forming the detector system. With the appearance of a γ-burst a device for detecting the burst above the background is triggered and a time analyzer registers the course of the burst in the energy window 50-150 keV for a period of 2 sec with a resolution of 15.625 msec, then for 32 sec with a resolution of 0.25 sec and then for 32 sec with a resolution of 1 sec. An important characteristic of the instrument is the possibility for autonomous determination of the direction of arrival of a γ-burst with its registry aboard one space vehicle using a system of 6 detectors of γ-radiation with an anisotropic angular response. The source of the γ-burst is unambiguously located within the limits of a small region in the sky with angular dimensions of several degrees by means of triaxial spatial stabilization of the space vehicle. During the period from September through December 1978, with a total exposure of 90 days, the "Konus" registered 27 γ-bursts and 120 solar flares of different intensity in the hard x-ray range. Nineteen γ-bursts were observed during a period of simultaneous instrument operation aboard both stations. A listing and the characteristics of the γ-bursts are given in a table. The time structure and energy spectra of the bursts are described in detail, followed by consideration of the distribution of γ-bursts with respect to intensity and maximum power and the distribution of sources in the celestial sphere. The distribution in the celestial sphere indicates that the sources are in our Galaxy. The degree of concentration of sources in the direction of the galactic center requires more precise determination. A strong concentration toward the center would mean that the mean distances to the sources of most observed γ-bursts are several kiloparsecs. In such a case the estimates of the mean energy release in the γ-range in the sources will attain 10^{40}-10^{41} erg. Figures 10, tables 1; references 11: 5 Russian, 6 Western.
[34-5303]

MEASUREMENTS OF FLUXES OF PROTONS AND α-PARTICLES ABOARD THE 'VENERA-11' AND 'VENERA-12' AUTOMATIC INTERPLANETARY STATIONS

VERNOV, S. N., TVERSKOY, B. A., BORODIN, N. F., GORCHAKOV, Ye. V., YELIZAROV, A. Ye., YERMAKOV, S. I., KADOBNOV, V. B., KONTOR, N. N., LYUBIMOV, G. P., MAYDYKOVSKIY, I. V., MOROZOVA, T. I., PERESLEGINA, N. V., SOBACHKIN, I. V., STEPINA, T. I., TULUPOV, V. I., FILIPPYCHEV, S. A., and KHOTILOVSKAYA, T. G.

[Abstract] An analysis of data on variations in the intensity of solar protons and α-particles and galactic cosmic rays obtained aboard the "Venera-11" and

"Venera-12" during the period from the beginning of the flight (September 1978) through March 1979 reveals a high level of solar activity and a great diversity of phenomena in the interplanetary medium. The high temporal resolution (20 minutes) and observation (together with the profiles of spectral intensity and the anisotropy of proton fluxes) of the intensity profiles of α-particles and intensity variations of galactic cosmic rays, makes possible a detailed analysis of the phenomena registered in the interplanetary medium and their connection with active processes on the sun. The paper presents a preliminary analysis of three particle intensity increases (beginning 23 September, 10 and 20 November 1978). The experimental results obtained must be compared with available theoretical models of the distribution of particles and models of active processes in the interplanetary medium for the purpose of further development of concepts concerning the physical processes of acceleration of particles and their distribution in the interplanetary medium and also concepts concerning the structure of the interplanetary medium during periods of high solar activity. Figures 5, tables 1; references 12: 6 Russian, 6 Western.
[34-5303]

'VENERA' MEASUREMENTS OF HIGH-ENERGY PARTICLES IN INTERPLANETARY MEDIUM

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[Abstract] In the experiment KV-77, carried out by the Scientific Research Institute of Nuclear Physics on "Venera-11" and "Venera-12," the fluxes, energy and angular distributions of electrons with energies $E_e \sim 0.05-2.3$ MeV and protons with $E_p \sim 0.8-230$ MeV in the interplanetary medium were measured at heliocentric distances $\sim 1.0-0.7$ a.u. with different solar activity levels. The main objective of the experiment was to obtain the spectral characteristics of bursts of solar cosmic rays. The data used were obtained in September-December 1978 on the flight trajectory from the earth to Venus. The measurements were made using a multi-detector system whose characteristics are summarized in a table. The article describes the measurement method. Particular emphasis is on description of the detectors used in measuring the proton spectrum in the interval 25-200 MeV and electrons in the interval 0.1-2.0 MeV (other components have already been described in the literature). The following are discussed in detail: spectrum of background high-energy electrons, spectra of burst particles, bursts of 23 September, 8, 9 October and bursts of hard electrons. Figures 6, tables '; references 17: 4 Russian, 13 Western.
[34-5303]

ESTIMATES OF WIND VELOCITY AND TURBULENCE IN THE VENUSIAN ATMOSPHERE ON THE
BASIS OF RELATIVE DOPPLER MEASUREMENTS ON THE AUTOMATIC INTERPLANETARY STATIONS
'VENERA-11' AND 'VENERA-12'

KERZHANOVICH, V. V., MAKAROV, Yu. F., MAROV, M. Ya., MOLOTOV, Ye. P.,
ROZHDESTVENSKIY, M. K., SOROKIN, V. P., ANTSIBOR, N. M., KUSTODIYEV, V. D.,
AND PUCHKOV, V. I.

[Abstract] Considerable additional information on dynamics of the Venusian
atmosphere was obtained as a result of experiments carried out on the "Venera-11"
and "Venera-12" stations. The measurement and data processing procedures are
described. The constructed wind velocity profile is shown as Fig. 3. The error
in estimating velocity is 5-7 m/sec. In a great range of altitudes movement
occurs with velocities 40-50 m/sec. The main increase in wind velocity occurs
at altitudes from 10 to 20 km, where the wind velocity gradient is ~4 m/sec·km;
above 20 km the increase in wind velocity is considerably slowed; the mean velocity
gradient from 20 to 60 km is less than 0.25 m/sec·km. In general, the wind
velocity distribution obtained using "Venera-12" data corresponds well to data
from the preceding "Veneras," which indicated the existence of constant strong
zonal movement of the troposphere. The descent module is also influenced by
dynamic atmospheric turbulence, manifested in fluctuations of wind velocity and
corresponding variations in descent module velocity (in contrast to temperature
turbulence, determining fluctuations of the refractive index and radio signal
parameters). Throughout the descent of the module considerable variations were
observed; these were more intense in the upper troposphere. During the descent
of the "Venera-11" above 40-45 km the mean amplitude of the velocity fluctuations
was ~1 m/sec with a maximum of 2.5 m/sec for the greatest variations; the time
scale for the greatest fluctuations was 30-40 sec, which corresponds to a spatial
scale of 600-800 m. For the "Venera-12" the maximum fluctuations were 3 m/sec.
Below 40 km the amplitude of the velocity fluctuations which can be identified
with the influence of turbulence was up to 0.4 m/sec, and the characteristic
time was from 10-12 to 16-20 sec. On the whole, the turbulence was stronger than
under similar conditions for the "Venera-9" and "Venera-10" and for the "Venera-5-8"
stations which sounded the morning and predawn atmospheres. Down to the deep
layers the Venusian atmosphere is affected by very strong, but nonuniform zonal
movement. Thus, a new type of circulation of a deep atmosphere has been discovered.
The mechanism by which it is maintained requires theoretical explanation and further
experimental investigations. Figures 5; references 15: 8 Russian, 7 Western.
[34-5303]

RAPID PROCESSING OF EXPERIMENTAL SCIENTIFIC DATA ON THE 'VENERA-11' AND 'VENERA-12' AUTOMATIC INTERPLANETARY STATIONS

GERNET, Ye. D., ZABIYAKIN, G. I., IL'IN, L. K., KRYLOV, V. A., MAGARSHAK, O. A., ONISHCHENKO, L. V., RUTKOVSKIY, A. I. and RYKOVANOV, B. N.

[Abstract] A new system for the rapid processing of scientific data operated during the flight of the "Venera-11" and "Venera-12" automatic stations and was employed in the routine collection and processing of telemetry information and experimental data from various instruments. The system began to function when the scientific instruments were switched on and continued to monitor the operation of the on-board scientific complexes along the entire flight trajectory as well as during operation of the descent modules. The apparatus for control and processing of scientific information (ACPSI) was created to process scientific information. It was installed at the site where telemetry information from the "Venera" stations was received. This apparatus was connected directly to the receiving channel and received all the scientific information arriving from the space vehicles (Fig. 1 is a diagram of the rapid processing system). The input of data flow was distributed by a commutator to direct visualization equipment (telemetry curve plotter), magnetic-tape telemetry recorder, and M-6000 minicomputer. During the reception process all or part of the information was stored. The ACPSI was connected by a telephone link to the Processing Center at the Space Research Institute. Despite the relative simplicity of data processing, with output to direct recording, direct visualization of the received information was an effective means for initial monitoring of operation of all the means for the reception of scientific data and the principal modes of on-board scientific systems, and during operation of the descent modeles is effective for the first evaluations of the scientific results of the measurements being made. Figures 3; references: 4 Russian.
[34-5303]

AUTOMATED PROCESSING OF DIRECT MEASUREMENTS IN VENUSIAN ATMOSPHERE

DERYUGIN, V. A., YELIZAROV, A. Ye., ZYRYANOV, N. N., KARYAGIN, V. P., KOZLOV, I. A., KREMNEV, R. S., KUZNETSOV, V. V., LOPATKIN, A. I., BURTSEV, V. P., PICHKHADZE, K.M. AND SUKHANOV, K. G.

[Abstract] The automatic system for processing results (ASOR) obtained by the descent modules of the "Venera" interplanetary stations in the planetary atmosphere was designed to solve two principal problems: rapid analysis of current data directly during the experiment for determining the parameters of the descent trajectory, dynamics of the vehicle, the state of on-board systems and ambient conditions in order to predict routinely descent and landing processes, implementation of the program of planned experiments, state of radio communication systems and modes, and rapid analysis, immediately after landing, of the totality of the

collected information in order to reconstruct the descent trajectory, determining the coordinates of the landing point, tie-in of the work program of the service and scientific apparatus to time and altitude and more precise determination of ambient conditions. The input parameters of the system are the results of measurements obtained by the on-board data-measurement system during the descent and landing of the space vehicle. The sensing elements of the data-measurement system are used in determining the following parameters: components of the acceleration acting along the longitudinal axis of the vehicle, the components of acceleration operative in the plane OYZ perpendicular to the longitudinal axis of the vehicle; the longitudinal component of the angular velocity vector; the transverse component of the angular velocity vector, atmospheric pressure and temperature. Structurally the ASOR consists of three main units: for primary processing, for secondary processing, and for data output. Each of these consists of a series of subunits. All the parameters of these units and subunits and their functioning are described in detail. The system proved to be highly effective, and ways for its further algorithmic and structural improvement were revealed. Table 2 shows the final results of measurements, separately for "Venera-11" and "Venera-12" for different trajectory segments (entry into atmosphere, aerodynamic braking, descent by parachute, descent on braking shield and landing) and different parameters (time, altitude, velocity, trajectory angle, maximum acceleration, etc.). Figures 1, tables 2; references: 8 Russian.
[34-5303]

BALLISTICS AND NAVIGATION OF 'VENERA-11' AND 'VENERA-12' AUTOMATIC INTERPLANETARY STATIONS

ABRAMOVICH, S. K., AGEYEVA, T. D., AKIM, E. L., ZASLAVSKIY, G. S., IVANOV, N. M., KAZANSKIY, M. A., LYASKOVSKAYA, V. I., MORSKOY, I. M., PAPKOV, O. V., POLYAKOV, V.S., STEPAN'YANTS, V. A., SUKHANOV, K. G., TIKHONOV, V. F. and KHEYFETS, V. N.

[Abstract] The ballistic characteristics of flights to Venus in 1978 did not make it possible to employ the orbital-descent flight scheme used in 1975. The increase in approach velocity to Venus considerably reduced the gravitational influence of the planet on the trajectory of motion of the orbital vehicle and resulted in a considerable decrease in the time for reciprocal radio communication between the descent modules and the orbital vehicles during its "loop" flight around the planet. This required the development of a fly-by - descent flight scheme which ensured ddelvery of the descent modules to the planet and transmission of the necessary data from the descent modules to the earth. This was achieved primarily due to optimization of the relative motion of the descent modules and orbital vehicles in all sectors of descent module operation and optimization of the parameters of the fly-by trajectory, which made possible the most effective use of the antenna systems of the descent module - orbital vehicle radio link. After the fly-by of Venus the orbital vehicles entered heliocentric elliptical orbits. After the fly-by this was used in creating a large triangulation base for detecting and localizing extraterrestrial sources of γ-bursts using apparatus installed on the orbital vehicle and artificial earth satellite.

Special trajectory corrections were made for the automatic stations in order to create the best conditions for localizing the sources of γ-bursts. The flight scheme, therefore, included the following basic operations: inserting the interplanetary station into an AES orbit and launching from an intermediate orbit at the end of the first revolution into an interplanetary transfer orbit, execution of two corrections in the transfer orbit ensuring the implementation of the conditions necessary for entry of the descent module into the planetary atmosphere and its landing in the selected region of Venus, separation of the descent module about 2 days prior to entry into the atmosphere and transfer of the orbital vehicle into a fly-by trajectory with parameters ensuring relaying to earth (via the orbital vehicle) a radio signal from the descent module during the descent sector and during its functioning at the planetary surface, and conducting a trajectory correction after the fly-by of Venus for maximum separation of the vehicles. Specific information is given on these individual operations. Figures 6, tables 1; references: 3 Russian.
[34-5303]

AERODYNAMICS AND DYNAMICS OF DESCENT MODULES OF THE 'VENERA-11' AND 'VENERA-12' STATIONS

KARYAGIN, V. P., KOVTUNENKO, V. M., KREMNEV, R. S., KUZNETSOV, V. V., PICHKHADZE, K. M., SKLOVSKAYA, I. A., PINCHENKO, V. S. and YAROSHEVSKIY, V. A.

[Abstract] The program for descent of the "Venera-11" and "Venera-12" space vehicles included a segment of uncontrolled flight of the descent modules following the release of parachutes and down to landing on the planetary surface. This stage in the trajectory represents about 85% of the total descent time. The velocity and nature of motion of the descent modules in this segment are governed by their inertial-mass and aerodynamic characteristics. This paper is devoted to a summarization of the aerodynamics and dynamics of the descent modules in this trajectory segment. The velocity of motion of the modules is determined from the condition of balance between the force of the weight G and drag X, whose value is dependent on the configuration of the modules, their geometric characteristics, atmospheric density and flight velocity. The latter, after the release of the braking parachute, did not exceed 50 m/sec and decreased to 8-7 m/sec at the moment of landing, which corresponds to Mach numbers from 0.15 to 0.02. Gas compressibility exerts no influence on the drag coefficient C_x. This coefficient also has virtually no dependence on the Reynolds number, whose value during descent from an altitude of about 50 km to the surface varies in the range from $Re = 10^7$ to $3 \cdot 10^7$. Figure 1 shows the influence of deviation of the drag coefficient ΔC_x from its nominal value during descent. Figure 2 shows the dependence of the drag coefficient on the angle of attack. With deviation of the module by angles of attack up to $\alpha = 30\%$ the change in the drag coefficient falls in the range +5%. Accordingly, motion about its center of mass within restricted limits ($\alpha < 15°$) exerts no influence on descent velocity. Other aerodynamic parameters are considered, such as perturbed motion of the module about the transverse axes OY and OZ: the two main orthogonal axes, which can be called inertial-aerodynamic

axes, are analyzed, as is the longitudinal angular velocity ω_x, which exerts an influence on the character of motion. Figures 9, tables 2; references: 3 Russian.
[34-5303]

ANALYSIS OF RESULTS OF MEASUREMENT OF PARAMETERS OF THE VENUSIAN ATMOSPHERE AT THE LANDING SITES OF THE 'VENERA-11' AND 'VENERA-12'

AVDUYEVSKIY, V. S., BORODIN, N. F., VASIL'YEV, V. N., GODNEV, A. G., KARYAGIN, V.P., KOVER'YANOV, V. A., KOVTUNENKO, V. M., KREMNEV, R. S., PAVLOVA, V. M., ROZHDESTVENSKIY, M. K., SERBIN, V. I., SUKHANOV, K. G., USPENSKIY, G. R. and CHEREMUKHINA, Z. P.

[Abstract] This paper gives the results of direct measurements of temperature and pressure for altitudes 0-50 km and indirect determination of atmospheric parameters for altitudes 70-105 km on the basis of measurements of accelerations during the period of aerodynamic braking of the "Venera-11" and "Venera-12" descent modules. The authors give a comparison of the results with data obtained by the earlier "Venera-9" and "Venera-10" stations and similar results from the descent of "Pioneer" probes as well the results of pressure and temperature measurements obtained by radio sounding of the atmosphere. During aerodynamic braking in the preparachute segment of descent module motion there were measurements of linear longitudinal and lateral accelerations along one of the transverse axes. The measurements were made using an inertial potentiometric sensor. The results of these acceleration measurements are shown in Fig 1. The results of temperature and pressure measurements are given in Fig 2. Figure 3 shows the dependence of pressure on temperatures determined from these measurements. Figure 4 gives the dependence of pressure on density. Figure 5 is a vertical profile of atmospheric pressure. Figure 6 is a vertical profile of temperature. Figure 7 shows the change in temperature as a function of altitude for the upper layers of the Venusian atmosphere. A table gives the P and T values at 5-km intervals from the surface to 105 km. Figures 7, tables 2; references 8: 6 Russian, 2 Western.
[34-5303]

FUNCTIONING OF 'VENERA' DESCENT MODULES IN VENUSIAN ATMOSPHERE

ZAYTSEV, A. V., KARYAGIN, V. P., KOVTUNENKO, V. M., KREMNEV, R. S., POKIN, V. G., PICHKHADZE, K. M., RODIN, A. L., SUKHANOV, K. G., TURCHANINOV, V. N. and FEDOROV, O. S.

[Abstract] This is a general introduction to this collection of papers devoted to the results of measurements made by the "Venera-11" and "Venera-12" and the descent modules. The article describes this space system in broad terms; no

references are cited and the figures and text duplicate information contained
in the press and literature. Objectives of the joint flight was exploration of
the planet and the surrounding environment, investigation of the interplanetary
medium, and implementation of the French-Soviet experiment for determining
γ-radiation sources and their intensity. Figure 1 shows the general appearance
of the "Venera" stations (12 components are identified); Fig 2 is a diagram of
landing stages of the descent modules (12 components or stages are annotated).
These two figures serve as a basis for much of the textual description. Emphasis
is on the descent modules, which collected most of the data reported in this
collection of papers. They carried instrumentation for measuring atmospheric
pressure and temperature during descent and at the surface, determining the com-
position of atmospheric aerosols, calculating the chemical composition of the
atmosphere by the gas chromatography method, investigating the chemical and isotopic
composition of the Venusian atmosphere by the mass spectrometer method, refining
data on the structure and optical characteristics of aerosol layers in the atmos-
phere, examining the structure and composition of the cloud layer and spectrometric
investigations of illumination, measuring linear and impact acceleration during
aerodynamic braking and landing, and recording electric discharges in the Venusian
atmosphere. Papers on all these subjects are published in this number of
KOSMICHESKIYE ISSLEDOVANIYA. Figures 4, tables 1.
[34-5303]

DETERMINATION OF INITIAL CONDITIONS FOR ENTRY OF A SPACE VEHICLE INTO THE MARTIAN
ATMOSPHERE USING A SEPARABLE NAVIGATIONAL PROBE

IVANOV, N. M. and BELYKH, V. D.

[Abstract] There are different methods for determining the vector of state of
a space vehicle using navigational satellites or planetary radio beacons by
measuring the relative range and radial velocity between the space vehicle and
the target objects. However, with respect to Mars the practical application
of these means involves considerable technical difficulties and their use in
the immediate future is problematical. It is, therefore, necessary to solve the
navigational problem using autonomous instruments which can be placed aboard a
space vehicle through nontraditional methods. Accordingly, the authors have
investigated the physical premises and give a general formulation of the problem,
examining the method for solving the problem of determining the initial vector
of state with entry of a space vehicle into the Martian atmosphere using a
navigational probe. The optimality criterion is formulated in a search for the
extremum. Rational relationships of design-ballistic parameters in a space vehicle
probe system are determined. The method for choosing the initial approximation
is considered. The effectiveness of application of the proposed algorithms under
the influence of various perturbing factors is investigated. Numerical results
are given for a specific case. It is shown that the use of additional information
in the form of relative measurements of range and velocity between the space

vehicle and the navigational probe in the inertial navigation system makes it
possible to determine the altitude of the conditional pericenter and the initial
altitude of entry with a limiting error not exceeding 3 km and 2 km respectively.
Figures 4, tables 1; references: 9 Russian.
[13-5303]

OPTIMAL CONTROL OF A SPACECRAFT IN THE ATMOSPHERE OF JUPITER

IVANOV, N. M., MARTYNOV, A. I. and SOKOLOV, N. L.

[Abstract] One way of reducing the load/acceleration factor for spececraft is
the creation of sp cecraft which have at their disposal aerodynamic buoyancy.
A study is made here of problems relating to the guided descent of a spacecraft
of the glider type in the atmosphere of Jupiter. The employment of the control
of aerodynamic buoyancy makes it possible to solve both the problem of reducing
the load/acceleration factor on the descent trajectory and a number of other prob-
lems such as minimizing heat flows on the spacecraft's surface and maximizing the
altitude at the end of the key aerodynamic braking section. The variational
problem is solved of minimizing the maximum load/acceleration factor on the des-
cent trajectory and a study is made of the influence of ballistic design charac-
teristics of the spacecraft on the maximum load/acceleration factor. The permis-
sible load/acceleration factor is assumed to equal 150 units and all problems
are solved on the basis of optimal positioning of the entry corridor with respect
to the altitude of the conventional pericenter. The assumption is made that the
spacecraft is controlled by changing the bank angle. A comparison is made of
the effectiveness of ballistic descent as opposed to utilization of the lift/drag
ratio and optimal control of it. Maximum load/acceleration factors in ballistic
descent in the atmosphere of Jupiter can reach 300 to 350 units. On the descent
trajectory total heat flows on the surface of the spacecraft reach 70 kW/cm^2
and the temperature reaches 10^4 °C. A twofold reduction in the load/acceleration
factor would result in an increase in the ratio of the mass of the payload to
the initial mass of the launched spacecraft and in considerable facilitation of
solving the problem of landing a spacecraft on the surface of Jupiter. The
creation of spacecraft utilizing aerodynamic buoyancy is an alternative to the
equally valid solution of minimizing the entry corridor and making a more precise
determination of atmospheric characteristics. The behavior of the ablative
shielding is discussed. Spacecraft are controlled by varying the effective
ratio of $K_{ef} = K_b \cos \gamma$, where K_b is the lift/drag ratio and γ is the space-
craft's bank angle. This method of control is that generally used for an air-
craft of the gliding descent type. The effective ratio can vary over the range
of $-K_b \leq K_{ef} \leq K_b$. The variational problems are solved by utilizing the necessary
conditions for optimality of Pontryagin's maximum principle. It is demonstrated
that the required twofold reduction in the maximum load/acceleration factor is
achieved by the addition of guidance for the spacecraft. Optimal guidance can

be of two types, depending on the initial conditions for entry and the ballistic design characteristics of the spacecraft: Type I takes place if the descent trajectory passes within the permissible region of phase coordinates, whereby control consists in one-time switching of the effective ratio from $-K_b$ to $+K_b$. Type II is used for descent trajectories with a section of travel in which the condition is imposed that the maximum load/acceleration factor less the permissible load/acceleration factor is less than or equal to zero. Here one-time switching of K_{ef} from $-K_b$ to $+K_b$ is carried out as the spacecraft is guided out of the section of equal load/acceleration factors and after it descends from it. Figures 10; references 8: 6 Russian, 2 Western.
[360-8831]

28

BODY MASS MEASUREMENT UNDER WEIGHTLESSNESS CONDITIONS

SARYCHEV, V. A., SAZONOV, V. V., ZLATORUNSKIY, A. A., SAMORUKOV, I. A., FREYDEL', V. R., KHLOPINA, S. F., YEGOROV, A. D., and SOMOV, V. I.

[Abstract] The article describes the properties of a mass meter, an instru ent for determining the mass of a cosmonaut's body under weightlessness conditions, installed on board "Salyut-5" and "Salyut-6." The mass meter consists of two cylindrical concentric pipes. The inner pipe is rigidly attached to a fixed base and has eight guides along which the outer pipe moves on roller bearings. As part of the mass meter moves relative to its fixed part, there is deformation of a spring component, which is composed of two successively arranged springs. The ends of the spring element are attached to the inner pipe and the middle is attached to the outer pipe. With such attachment one spring works on dilatation and the other works on compression. The moving part of the mass meter is in a "zero" position when the forces of the springs are mutually compensated. In the upper part of the outer pipe there is a platform for placement of the cos-monaut's torso and in its lower part there are handles for the hands and supports for the feet. On the outer pipe there is a boss which, when this pipe is in a zero position, intersects the slots of an induction-type contactless sensor. With each passage of the moving part of the mass meter through a zero position, an electric pulse is fed to the intake of the unit for measuring the period of oscillation. The period is measured automatically in the third period of the oscillations with an accuracy to 0.001 sec. When measuring body mass the cosmonaut places himself on the platform "on his stomach" (see figure). The cosmonaut rests his chin on an extendable support, which holds the head steady. The hands are on the handles and the feet are on the supports. The supports secure the legs from the feet to the hips between the supports and the edge of the plat-form. With the press of a button the moving part of the mass meter is freed from its fixed position and begins to oscillate. The cosmonaut's body mass is ascertained from the period of these oscillations. The article describes the method for checking the mass meter under ground conditions and the method

for measuring mass under weightlessness conditions and gives the results of
measurements of the body mass of cosmonauts aboard the "Salyut" stations.
Figures 4, tables 6; references 5:   4 Russian, 1 Western.
[13-5303]

THE 175-DAY SPACE FLIGHT -- SOME RESULTS OF MEDICAL INVESTIGATIONS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 9, 1980 pp 49-58

GAZENKO, O. G., academician, and YEGOROV, A. D., doctor of medical sciences

[Abstract] The flight of the third main expedition on the "Salyut-6"-"Soyuz"
orbital complex in 1979 was unprecedented in duration: 175 days. This article
summarizes the medical investigations of cosmonauts V. A. Lyakhov and V. V. Ryumin
during the flight and post-flight periods (a detailed report will be published
at a future date). The conditions under which the flight transpired are briefly
reviewed (information is given on such subjects as composition of the atmosphere
in the ship; total irradiation dose; weight and body measurements prior to and
during the flight; parameters of the respiratory and cardiovascular systems;
arterial pressure and pulse blood filling of cerebral vessels; EKG investigations;
tolerance under physical loads). It is postulated that the principal factor
governing physiological changes in the body under spaceflight conditions is
weightlessness and that the primary link in the mechanism of the latter is a
decrease in the functional load on a number of systems due to the absence of
weight and the associated mechanical stressing of body structures. The infor-
mation given on the readaptation period includes: feelings of well-being; motor
functions; water-salt metabolism; hematological investigations; immunological,
microbiological and allergological investigations. All these medical investigations
revealed that man can not only adapt to a half-year exposure to spaceflight

conditions, but also actively work under these conditions, carry out complex scientific-technical experiments, and work outside a spaceship. Active medical monitoring and medical examinations of the crew, in combination with a rational work and rest schedule, fully adequate diet, sufficient water intake and sleep of adequate duration, ensured maintenance of good health and performance of crew members during the 175-day flight; it led to a moderation of reactions and the course of the readaptation process during the post-flight period. The observed changes in various body systems at rest and during functional tests during all phases of the flight and after its completion had an adaptive character and were not adversely reflected in the performance of the cosmonauts and in the implementation of the flight program. During and after the flight there were no substantial changes in the health of the cosmonauts impairing the planned lengthening of space flights. The data collected under the "Salyut-6"-"Soyuz" program on the body reactions to spaceflight factors will make it possible to define more clearly the principal directions in further medical investigations applicable to future space flights. Figures 5, tables 1.
[15-5303]

MORPHOGENESIS OF THE FRUITING BODIES OF POLYPORUS CILIATUS FR. EX FR. UNDER SPACE FLIGHT CONDITIONS

KASATKINA, T. B., ZHARIKOVA, G. G. and RUBIN, A. B., Institute of Applied Mathematics imeni M. V. Keldysh of the USSR Academy of Sciences, Moscow, and Moscow State University imeni M. V. Lomonosov

[Abstract] Two experiments describing the growth of the pore fungi Polyporus Ciliatus on board the "Salyut-5" and "Salyut-6" space stations are treated. In the first series of trials on "Salyut-5", a culture with rudiments of the fruiting bodies no longer than 2 mm was delivered to the station; two test tubes with the culture were placed to a light source, while four remained in total darkness throughout the experiment. A similar experiment was run in the ground laboratory. After 17 days the fungi were returned to earth and compared with those in the laboratory. Fruiting bodies developed in all six test tubes, and all six from space were aberrant. The second experiment performed on "Salyut-6" used fungi cultures grown in test tubes with a large culture medium surface area. The culture was delivered to the station in the stage of mycelium proliferation to test the possibility of the filling of the fruiting bodies in weightlessness. Again the trial was run for 20 days in darkness and light. The differences between the fruiting bodies of the illuminated and dark test and control groups are described and summarized in tabular form. Fruiting bodies were obtained for the first time which had developed caps, having undergone morphogenesis without gravity. If the rudiments of the fruiting bodies were formed in the earth's gravity, their development continues in space and also in gravity both in light and darkness. If the culture were placed in the weightless environment prior to the formation

of the rudiments of the fruiting bodies, their formation continued only in light. This work indicates the basic possibility of the development of fruiting bodies of hymenomycetes in a weightless environment. Figures 6; references 7: 4 Russian, 3 Western.

Figure 1. The fruiting bodies of P. Ciliatus, developed from rubiments in the case of illumination in the "Salyut-5" station.

Key: a,b. Trial;
     c. Control

Figure 2. The fruiting bodies of P. Ciliatus, developed from rudiments without light in the "Salyut-5" station.

Key: a,b. Trial;
c. Control.
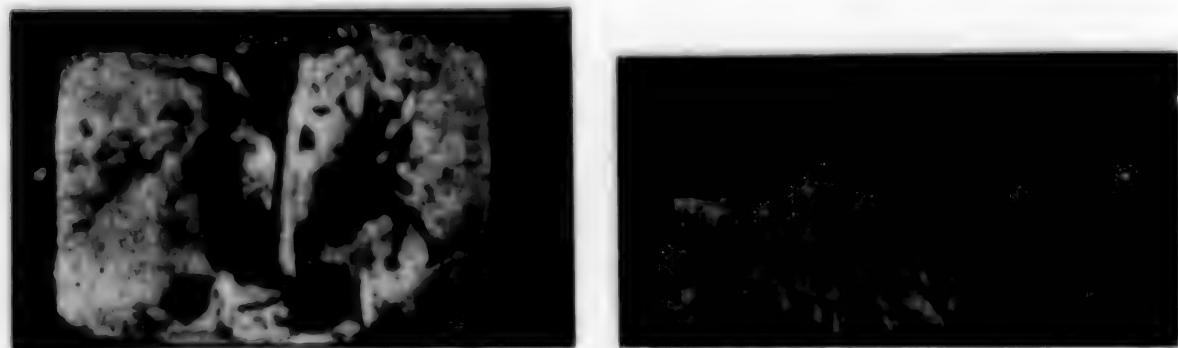
Figure 3. The fruiting bodies of P. Ciliatus, formed and developed in the IFS-2 chamber with illumination in the "Salyut-6" station.

Key: a. View from above;
b. External surface.

Scale = 1 cm; the same for Figure 4.
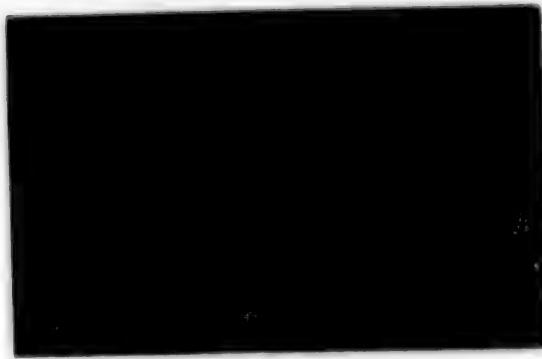
Figure 4. 15 fruiting bodies from the IFS-2 chamber in the "Salyut-6" station.

Figure 5. The fruiting bodies of P. Ciliatus, obtained in the laboratory in IFS-2 chamber with lighting.
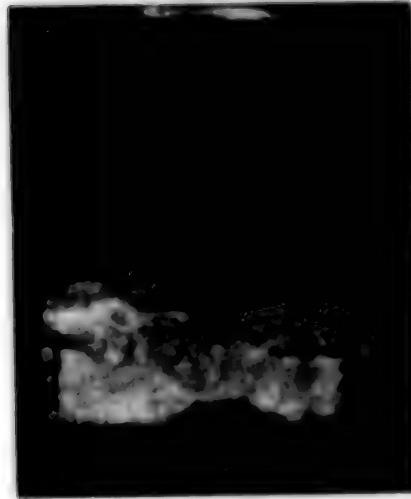
Figure 6. P. Ciliatus mycelium, developed in the IFS-2 chamber without light in the "Salyut-6" station.

[1-8225]

34

SPECIFIC FEATURES OF CEREBRAL BLOOD CIRCULATION OF THE CREWS OF THE SALYUT-4 SPACE STATION AT REST AND WHEN PERFORMING FUNCTIONAL TESTS

KAS'YAN, I. I., VAYNSHTEYN, G. B., SEMENYA, V. N., GOROKHOV, K. A., TIKHONOV, V.P., PONOMAREV, S. I. and ASANOV, Kh. Kh., Institute of Evolutionary Physiology and Biochemistry imeni I. M. Sechenov of the USSR Academy of Sciences, Leningrad and the Institute of Medical and Biological Problems of the USSR Ministry of Public Health, Moscow

[Abstract] The portable "Levkoy-3" rheoencephalographic transducer was used to determine the changes in the response of cerebral vessels to functional loads during long-term exposure to weightlessness for four cosmonauts during the first two Salyut-4 missions: V. I. Sevast'yanov, P. I. Klimuk, A. A. Gubarev and G. M. Grechko. The crews were stressed by the following loads: 1. Negative pressure on the lower half of the body of -25 and -35 mm Hg for 5 to 10 minutes; 2. A physical load on a bicycle ergometer of 450 to 600 μ g for four to five minutes. The tests were run three to seven days prior to flight, during the mission and in the post-flight period (up to 10 days after landing). The rheoencephalograms were transmitted to a ground station for the analysis; the physiological responses of the individual crew members are treated in detail. During the flight, when subjected to lower body negative pressure, a reduction in the pulse blood filling of the vessels of the cerebrum and an improvement in the venous outflow from the cranial cavity were noted for all crew members. This indicates the effectiveness of compensatory and adaptational reactions to weightlessness and the positive impact of prophylactic measures taken during the flight. The variations in the rheoencephalographic indicators for the case of rarefaction were basically the same as in the preflight tests, though individual differences are noted. All cosmonauts exhibited a substantial increase in the indicators for pulse blood inflow to cerebral vessels in response to muscular loading as compared to the preflight tests on the bicycle ergometer. The main indicators of the encephalograms normalized three to seven minutes after the end of the tests. For both tests, venous outflow from the cranial cavity was facilitated and there were complex reactions of various groups of vessels which tended to improve blood flow through the brain. These reactions were quite pronounced after the third to fourth week of weightlessness, but fell off by the 53rd to 60th day of the mission. Characteristic of the early post-flight period are paradoxical reactions of the encephalographic indicators to the same loads, and an increase in the time for the restoration of the indicators following the loads. The responses of Sevast'yanov and Gubarev were less stable than those of Klimuk and Grechko, where Sevast'yanov showed more pronounced reactions to the ergometer loading and Gubarev to the lower body negative pressure. Figures 6; references 14: 9 Russian; 5 Western.
[366-8225]

CLINICAL PICTURE AND ACTIVITY OF NERVOUS SYSTEM MEDIATORS IN THE CASE OF LONG
TERM SIMULATION OF CERTAIN SPACE FLIGHT CONDITIONS

KRUPINA, F. N., USHAKOV, G. K., MASLOVA, A. F. and TIZUL, A. Ya.

[Abstract] Some 18 male volunteers from 32 to 41 years of age were subjected
to a test of nervous sytem and neuromediator activity with 182 days of anti-
orthostatic bed confined hypokinesia (-4o) and a 54 day recuperative period.
The subjects were divided into three groups of six each, with different prophylac-
tic training regimens for the first two groups and the third group served as the
control without the preventive exercises. The status of the nervous system
was studied by clinical neurological methods daily for the first 8 days and once
every 10 days thereafter; blood neuromediators (adrenalin, noradrenalin and
acetylcholine) were measured polarigraphically once every 18 to 20 days during
the trial period and at fixed days during the rehabilitation. The dynamics
of neuromediator activity of the blood during the hypokinesia and readaptation
are plotted graphically for all three groups as a function of time. The accom-
panying subjective sensations are described along with all of the various clinical
manifestations: hemodynamic disturbances, sleep degradation, neuromuscular
disturbances, changes in the nature and duration of vegetative reflexes as well
as pain and statokinetic symptoms. The results of the study reveal the necessity
for further refinement of the tools and methods for prophylaxis and treatment of
disorders occasioned by weightlessness, as well as for a differentiated and more
rigorous approach to the treatment of patients with long bed confinements.
Figures 5; references: 5 Russian, 1 Western.
[2-8225]

EFFECT OF PROLONGED SPACEFLIGHT FACTORS ON THE SKELETAL CONDITION OF TORTOISES

STUPAKOV, G. P., VOLOZHIN, A. I., KORZHEN'YANTS, V. A., YAGODOVSKIY, V. S.,
POLYAKOV, A. N., KOROLEV, V. V. and ELIVANOV, V. A.

[Abstract] Study of skeletal changes under weightlessness conditions is a timely
problem due to a possible decrease in the strength of bones and therefore their
tolerance to accelerations, such as during the landing of a descent module.
The authors, therefore, studied the strength of the compact and spongy matter
in tortoises which had experienced space flights with a duration of 18, 22, 60
and 90 days in comparison with the state of the mineral component and the quan-
titative indices of porosity of bone structures. The investigations were made
using 30 tortoises (Festudo Horsfieldii Gray) of both sexes and weighing 180-545 g.
Aboard the spaceship 10 animals were kept in metal cages and received no food

during the flight. A "simultaneous experiment" was carried out on the ground
with 8 animals, kept in similar cages and receiving no food. Twelve animals,
the control group, were kept in a vivarium and received their usual food. The
"space" animals were sacrificed two days after the landing. The exact procedures
in preparing and processing the bones are described in detail. Data for the
different groups are compared. Under the influence of spaceflight with a duration
of 60-90 days a limited osteoporosis developed in the epiphyses and metaphyses
of the long tubular bones of the animals which had experienced weightlessness.
The resorption of bone matter is not accompanied by a decrease in the mineral
saturation of the remaining microstructures; this can explain published data on
the absence of changes in the microhardness of bone tissue in cosmonauts. A
decrease in strength of the spongy bone of the epyphyses in tortoises after space-
flight is related to a decrease in the total mass of bone matter and possibly
a change in the properties of its structure. The strength of the compact matter
did not change. The development of osteoporosis and the decrease in bone strength
in tortoises under weightlessness conditions indicates that the problem of the
influence of spaceflight factors on the skeleton must be addressed in a timely
manner. Figures 2, tables 2; references 6: 5 Russian, 1 Western.
[232-5303]

ON APERTURE SYNTHESIS USING A SPACE RADIOTELESCOPE

KARDASHEV, N. S., POGREBENKO, S. V. and TSAREVSKIY, G. S., Space Research Institute of the USSR Academy of Sciences

[Abstract] Aperture synthesis using a radiotelescope in a low orbit around the earth (300 - 400 km) and a ground radiotelescope (the proposed system designated RAKSAS-1) can be used to produce an equivalent synthesized aperture on the order of the earth's diameter and generate radio images which are unambiguous and independent of the modeling concepts. Analytical expressions are derived for the synthesis patterns and applied to the case of the RAKSAS-1 with a ground radiotelescope at a latitude of 45° and an orbiting telescope with a period of 92 minutes an altitude of 350 km and an orbital inclination of 52°. The spatial frequency spectrum coverage (the uv plane) plotted from computer modeling is shown for this system and two others: very long baseline interferometry (VLBI) with two ground radiotelescopes used as an interferometer and very long baseline astronomy (10 ground radiotelescopes in a global aperture synthesis mode). The following conclusions are drawn: 1. The filling of the uv plane by the RAKSAS-1 system is much better than with the intercontinental two element VLBI system; 2. The filling of the uv plane by RAKSAS-1 over 24 hours averages much better than with the use of the multiantenna (up to 10 antennas) global interferometers, and extending the observation period beyond 24 hours shows RAKSAS-1 performance exceeding the possible level for VLBA systems; 3. Where a weak source is observed for 24 hours, the information derived from the RAKSAS-1 averages one-third of the VLBA system (with 10 telescopes), which is due to the considerable difference in the gathering areas. In compiling the time linked observational programs for RAKSAS-1 systems, the right ascension of the sources and the precession of the orbital plane of the space telescope must be taken into account to obtain optimal filling of the spatial frequency spectrum for each source. Figures 8; references 12: 9 Russian; 3 Western.
[355-8225]

OPTIMUM IMPLEMENTATION OF A SPACE RESEARCH PROGRAM USING A LIMITED NUMBER OF CARRIER-ROCKET TYPES

OFITSEROV, V. P.

[Abstract] A study was made of methods for solving problems arising in validation of the choice of a system of carrier-rockets for optimum implementation of a space research program. The optimality criteria are the minimum time and minimum cost of implementing the program. The number of types of carrier-rockets is considered limited. The author takes into account the possibility of simultaneous work on several types of carrier-rockets as well as the possibility of their single and multiple launchings. In the solution an approach based on the ideas of dynamic programming was used. The formulated algorithms can be used in automated planning systems and in the solution of a variety of problems. In a specific example it is shown that the proposed approach is more universal than those considered earlier (A. V. Sollogub, V. P. Ofitserov, KOSMICH. ISSLED., 15, No 6, 1977; 16, No 4, 1978). It makes it possible to take into account without difficulty many limitations which can arise in validating the choice of types of carrier-rockets for implementing a program of space vehicle launchings. References: 2 Russian.
[13-5303]

ANALYSIS OF DYNAMICS OF A SYSTEM USING GRAVITATIONAL-GRADIENT AND GYROSCOPIC STABILIZATION PRINCIPLES

MAYOROV, V. A., POPOV, V. I. and YANOV, I. O.

[Abstract] A study was made of a combined system for the triaxial stabilization of an artificial satellite using gravitational-gradient and gyroscopic stabilization principles. In a working position the system has the form of a dumbbell consisting of two bodies: main and auxiliary, containing a flywheel, which are connected by a shaft. The proposed system differs from earlier known gravitational stabilization systems in that for the purpose of ensuring the stabilization of the space vehicle with respect   se and banking angles restoring mements are created due to the gyroscopic properties of the rotating flywheel mounted on the end of the shaft. Full consideration is given to the damping of oscillations of the elastic system due to the scattering of energy in the shaft and the damping of oscillations in the system by means of a magnetic damper. The practical application of such a combined system is illustrated in a specific example. With the parameters selected in this particular case it was found that the amplitude of the nutational oscillations decreased by a factor of 20 in about 7 revolutions in orbit, whereas

the amplitude of precessional oscillations in the lateral plane decreased by a factor of 20 in about 25 revolutions. In the pitching plane there were periodic oscillations with a maximum deviation $|\vartheta| \leq 0.06$ rad. Figures 2; references: 5 Russian.
[13-5303]

CRITERION FOR TUNING GYRO PROPULSION SYSTEMS

TOKAR', Ye. N.

[Abstract] A theoretical discussion is presented of characteristics of the control moment of extra gyroscope systems for spacecraft, using as an example one-axis gyroscopes, i. e., gyrodynes. It is assumed that a system of s propulsion-type gyroscopes designed for controlling the orientation of a spacecraft is installed on the spacecraft. The position of the gyroscopes' intrinsic kinetic moments, Γ_k, constant in absolute value, where Γ_k = const and k = 1,2, ..., s, in relation to axes Oxyz connected to the spacecraft, and the value of their sum, H, also, are determined by angles ξ_i, where i = 1, 2, ..., n and $n \geq s$, which equal the angles of turn of the gyro units around their axes of suspension. Represented by ξ and $\dot{\xi}$ are n-dimensional vectors, and by u the vector of control effects influencing the gyroscopes. The control moment produced by the gyroscopic system equals $M_g = -M - \omega \times H$ and $M = \dot{H}$ is the local derivative of vector H in axes Oxyz and ω is the angular velocity of these axes. It is assumed that M is related to u by the equation $M = I(\xi)u$. Vector u is broken down into the components u_1 and u_2 satisfying the equation $I(\xi)u_1 = M^*$, where M^* is the value of vector $M = \dot{H}$ required for controlling the orientation of the spacecraft and $I(\xi)u_2 = 0$. Component u_2 keeps vector $H = \sum_{k=1}^{s} \Gamma_k$ unchanged in axes Oxyz and thus represents the tuning law for the gyroscopic system. The control vector, u_2, can be plotted according to the principle of maximizing a certain function, i.e., of a tuning criterion: $\mu(\xi) = \mu(\xi_1, \xi_2, ..., \xi_n)$. This function should be such that with all values of H its maximum will result in a configuration of gyroscopes, ξ, which is best in a certain sense. A requirement for ξ is that it be maximally remote from singular points, ξ^*, peculiar to the system in question. A discussion is given of certain variants for the selection of $\mu(\xi)$ on the basis of this requirement. Special attention is devoted to systems consisting of n identical one-axis gyroscopes. Assuming that $\omega = 0$, $M_g = -M$; the characteristics of this control moment under this condition are discussed independently. A system of six gyrodynes is discussed with suspension axes p parallel pairwise to axes Oxyz. A polyhedron is constructed to describe the system. Utilizing the results of the analysis, a comparison is made of the moment characteristics of extra gyro propulsion systems with similar characteristics of other actuating units used in systems for orienting a spacecraft. It is demonstrated that the moment characteristics of extra gyroscopic systems are considerably less stable than those of other actuating units. This makes it necessary to use

in controlling them relatively complex command signals formed by the on-board computing complex. Criteria are found which are rather complex, but which have the advantage that they serve as a measure of the deviation of vector ℓ from singular values of ℓ^* and therefore satisfy the requirements formulated. It is stressed that the selection of the most simple and sufficiently effective tuning criteria, $\mu(\ell)$, is an independent problem which must be solved by utilizing the specific properties of specific gyroscopic systems. Figures 5; references: 5 Russian.
[360-8831]

ESTIMATE OF THE EFFECTIVENESS OF INDEPENDENT REPEATED CORRECTION

DEMIDOVICH, O. B.

[Abstract] The concept of the relative effectiveness of repeated independent correction is introduced for the purpose of facilitating an estimate of the feasibility of making these corrections. Just the section around the planet for which independent corrections can prove to be necessary is discussed and as the navigation measurements are assumed a measurement of the angular diameter of the planet and a measurement of the angles between the lines of sight of the planet and two stars. The relative effectiveness of n-fold correction is $p_n = W_1/W_{\Sigma n}^*$, where W_1 is the one-time correcting pulse ensuring the same accuracy of crossing the plane of the figure as the $W_{\Sigma n}^*$ optimal total correcting pulse for n-fold correction. A model of n-fold correction is constructed for the purpose of finding an approximate expression for p_n. An expression is derived for the total correcting pulse and for the optimal total correcting pulse. The problem is discussed of what number of corrections it makes sense to make. It is shown that if n-fold and one-time three-parameter corrections ensure the same accuracy of falling into the plane of the figure, ℓ, with the same initial deviation from the nominal trajectory, Δ, then the relative effectiveness of n-fold correction as compared with one-time is a function only of parameter Δ/ρ and of the number of corrections, n: $p_n = k_1(n)(\Delta/\rho)^{k_2(n)}$. It is demonstrated that the relationship between Δ and ρ is described by elementary functions. The results of a qualitative study make it possible to assume that in a precise formulation the ratio of the one-time correction pulse to the optimal total n-fold correction pulse will be in the form of $p_n = \phi(n)(\Delta/\rho)^{\psi(n)}$, where $\phi(n)$ and $\psi(n)$ are certain functions of the number of corrections, n, alone. Precise calculations are made for the purpose of estimating the degree of certainty of this assumption. Curves are given for the relationships $\ln p_n = f(\ln \Delta/\rho)$ for twofold and three-fold correction in a flight to Mars. Similar curves are given for a flight to Jupiter. All these curves prove to be linear, which agrees with the qualitative investigation. The slopes of the individual curves also agree well with the theoretical values, all of which makes it possible to conclude that in the case of three-parameter correction in a flight to a planet the relative effectiveness

of repeated corrections, p_n, depends, in addition to the number of corrections, only on the ratio of the original deviation of the trajectory from the nominal to the required accuracy of crossing the plane of the figure, Δ/ρ. The relative effectiveness is greater, the greater the ratio of Δ/ρ. It makes sense to carry out repeated corrections if high relative accuracy in crossing the plane of the figure is necessary. The case of two-parameter correction, i.e., correction of only the coordinate and plane of the figure, is considered. The majority of space flight problems do not require correction of the arrival time in the hovering section of the trajectory. Results analogous to these of the three-parameter problem are obtained. Figures 3; references 1: 1 Russian.
[360-8831]

CONTROL OF THE ORIENTATION OF A GYROSTAT SATELLITE IN ORBIT IN EARTH'S UMBRA

ZLOCHEVSKIY, S. I.

[Abstract] A discussion is given of the problem of establishing program control of the values of the kinetic moments of three flywheels installed in a satellite by means of which it is possible for a limited time to maintain the prescribed orientation of the satellite when the optical sensing units for angles or orientation are found in the dark. The satellite's orientation system consists of three controlled flywheels whose axes of rotation are parallel to the major central axis of inertia of the gyrostat. The orientation system includes three optical orientation angle sensors. The satellite moves in a high circular Keplerian orbit. An orthogonal barycentric system is used as the orbital system of coordinates. Axis OR_1 is directed along the tangent to the orbit in the direction of movement of the gyrostat's center of mass and axis OR_3 along the extension of the geocentric radius vector of the gyrostat's center of mass and the axes of coupled system of coordinates $Ox_1x_2x_3$ are directed along the major central axis of inertia of the gyrostat. Beginning with instant of time $t_0 = 0$, the optical sensors are found in the dark and for a certain period of time information on changes in angles of orientation is not fed to the orientation system. The problem discussed is that of finding rules for a program change in the values of the kinetic moments of the three flywheels which will ensure orientation of the satellite with errors not greater than the values of these errors at the initial moment of time, i.e., $|\alpha_i(t)| \leq |\alpha_i(0)|$. On the assumption that $\alpha_i(t)$ is a low value, equations are written for slight variations of the gyrostat satellite relative to the orbital trihedron under the effect of the gravitational moment and the constant moment $M(\bar{m}_1, \bar{m}_2, \bar{m}_3)$, representing the average value of the moment from the ejection of gas from the body when the satellite travels in a circular orbit with an angular velocity of ω. Kinetic moments $h_i = h_i(t)$ are found from the system of equations derived by assigning different laws for changes in angles of orientation, $\alpha_i(t)$. Three cases are discussed: 1) the simplest case when the original values of angles of orientation are kept unchanged over a specific time interval;

2) when the angles of orientation decrease over time; and 3) when the angles
of orientation are decaying periodic functions of time. In case 2) it is assumed
that the equations of motion are easily integrated in terms of the kinetic moments
of the flywheels. References 5: 5 Russian.
[360-8831]

EVALUATION OF THE ACCURACY OF METHODS OF CONSTRUCTING A LOCAL VERTICAL BY MEANS
OF AN OPTIMAL SCANNING DETECTOR OF OPTICAL SIGNALS

DOLONIN, N. A.

[Abstract] Two systems are discussed for estimating the angle of the direction
to the center of the earth. Discussed in particular is a receiver which can
be used for plotting a local vertical on an artificial earth satellite. This
receiver represents a system which determines the moment of the appearance of the
earth's natural radiation in the infrared region. Angular coordinates in systems
of this sort are determined completely by the moment of appearance of the signal.
If the error in estimating the appearance of the signal from earth is designated
as τ, then the variance of τ will serve as a sufficient characterization of the
operating quality of a system for determining the moment of appearance of the
signal. That system is optimal which produces minimum variance in τ. When
process $y(t)$ reaches at the output of the system a certain threshold value of C,
the signal has appeared. Process $y(t)$ represents the sum of the regular component,
$s(t)$, determined by the receiver's scanning system and the random component,
$N(t)$, caused by the internal noise of the receiver per se and external distortions
and noise in the useful signal representing the earth's natural radiation. The
moment of appearance of the signal equals $t = t_0 - \tau$; when τ is slight, the
variance of error τ equals $\sigma^2 = \sigma_N^2/[s'(t_0)]^2$, where σ_N^2 is the variance of the
noise and interference components and $s'(t_0)$ is the slope of the front of the
received pulse at level C. Optimization thus reduces to the following: selecting
an optimal threshold, C, which is equivalent to selecting an optimal value of
t_0; increasing the slope of the front of the useful signal, $s'(t_0)$. For the
latter purpose it can be advantageous to convert $y(t)$ before feeding it to the
threshold unit. Optimization is possible by including either an ideal low-
frequency filter or a certain correcting filter having the purpose of increasing
the slope of the front of the incoming pulse, which should result in a reduction
of σ_τ. It is demonstrated that the threshold circuit which is optimal in the
sense of a minimum error in determining the direction to the center of the earth
is in the form of a linear filter, in this case a bolometer, whose output is
connected to the input of an ideal low-frequency filter with an optimal band or
to the input of a correcting filter with optimal transient response. The signal
is supplied from the outputs of these devices to the threshold unit which makes
a decision regarding whether or not the instant for the arrival of the signal
is at hand. A highly simple threshold circuit of this sort produces a relatively

low error of 6.6' with an ideal filter and 5.8' with a correcting filter. This
circuit can be used in practice for purposes of orienting artificial earth satel-
lites and spacecraft. Circuits of this type are simple, easy to implement and
evidence high-quality performance. Figures 4; references 9: 9 Russian.
[360-8831]

ON THE QUESTION OF PREDICTING THE ROVING CAPABILITY OF A PLANETARY EXPLORATION
VEHICLE

AVONIN, Ye. V., ALEKSANDROV, A. L., and KEMURDZHIAN, A. L.

[Abstract] The most important factor in predicting the roving capability of a
planetary exploration vehicle is the extent of the field of vision of the vehicle's
onboard sensors. The authors divide them into two categories -- long range and
short range -- and then discuss a method for solving the problem of predicting
a planetary exploration vehicle's angular position during rectilinear movement
in the short-range scanning zone. The formulas that they derive err on the side
of caution, but in view of a planetary exploration vehicle's unique mission,
it is better to have an excessive number of stops and maneuvers than to risk
a complete loss of mobility. Figures 4; references 5.
[317-11746]

PLOTTING THE RELIEF OF A SURFACE FROM THE RESULTS OF RECORDING DYNAMIC PARAMETERS
OF PLANETARY LANDERS

AVOTIN, Ye. V.

[Abstract] A description is given of a method of measuring the relief of the
ground surface of a planet by means of a surface vehicle as it moves over the
terrain. The system for measuring the relief consists of sensing devices which
record the motion of suspensions, strain on the wheels, the path traveled, the
angles of inclination of the vehicle in the vertical-longitudinal and vertical-
transverse planes, a computer and a recording instrument. It is demonstrated
that in order to measure the differential in the heights of irregularities of the
relief taking into account the angles of inclination of the surface in the vertical-
longitudinal and transverse planes it is necessary to know the strain on the
wheels and suspension and also the angles of inclination of the transport vehicle

in the vertical-longitudinal and transverse planes. The strain on the wheel is measured by measuring, by means of the sensing device for the suspension's motion, the vertical reaction exerted against the wheel. The strain on an individual wheel depends on the characteristics of the elastic elements of the suspension and wheel. The computer makes a determination of the strain on an individual wheel with reference to the characteristics of the elastic element of the wheel. For this purpose two nonlinearity units are employed which reproduce the elastic characteristic of the suspension and of the wheel, respectively. The method makes it possible to read heights of the relief as read from a specific constant horizontal level, as well as angles of inclination of the surface along which the vehicle moves. Able to be used as reference points for reading the horizontal level are the points of contact of the rear wheels with the surface before the vehicle begins to move. Here the rear wheels are used to measure the relief. Equations are presented which make it possible to calculate not only the heights of the relief for the right and left sides, but also to determine on account of which factors the heights of the relief under the wheels of the right and left sides do not agree. These factors can be transverse inclination of the surface, i.e., the vehicle moves over the surface at a transverse angle of inclination; and both transverse inclination of the surface and variation of the relief in terms of the surface under the right and left sides. On the basis of a solution to the equations presented, it is possible to plot the relief and chart the terrain along the vehicle's route for two planes passing through the wheels of the right and left sides. A block diagram is shown of the equipment used for the purpose of implementang the equations. The motion of the suspensions can be measured by means of slide-resistance sensing elements, the strain on a wheel by means of an electronic sensing element in which the elastic characteristics of the suspension and wheel are reproduced, and the angles of inclination of the vehicle by means of a sensing element for measuring angular displacement, e.g., of the DK-6MT type. The path traveled can be measured by means of a speedometer or odometer. The surface vehicle can be furnished with a laser range-finder which scans in the vertical-transverse plane, thereby extending the range for measuring the relief and charting the terrain. A major advantage of the method described is that it does not require the use of suspended equipment. The computing operations involved in measuring the relief can be simplified considerably if the surface vehicle is equipped with rigid wheels. Figures 4; references: 9 Russian.
[360-8831]

ON THE EFFECT OF MONITORING ONBOARD MEASURING FACILITIES DURING FLIGHT ON THE QUALITY INDICATORS OF THE RENDEZVOUS PROCESS FOR TWO SPACECRAFT

GUBONIN, N. S., KARETKO, A. I. and KRINITSIN, L. V.

[Abstract] The reliability of the rendezvous of two spacecraft depends primarily on the reliability of the onboard measuring facilities and the control system. Since the latter functions only at discrete moments of time, it can also be

used to monitor and perform preventive maintenance on the former when it is not otherwise engaged for trajectory corrections. The authors discuss two cases of interruptions of measurement information input into the control system that are caused by preventive maintenance. In the first, all preventive maintenance operations are of a fixed duration and are performed immediately after actuation of the correcting impulses. In the second case, there is some lag in implementation. Although the latter involves greater expenditure of the characteristic velocity reserve, it has the important practical advantage of eliminating the transmission of spurious information (because of measuring equipment failure) to the control system. Figures 3; references 3.
[317-11746]

SOME RESULTS OF THE INTERACTION OF A STREAM OF RAREFIED GAS WITH THE SURFACE OF AN ARTIFICIAL EARTH SATELLITE AND AN INTERPRETATION OF DATA ON ITS DECELERATION

BASS, V. P.

[Abstract] It is possible to describe in different ways the nature of the exchange of momentum between particles of an oncoming stream and the surfaces of spacecraft, i.e., at the level of interaction potentials, scattering factors and exchange coefficients. For the purpose of determining integral aerodynamic characteristics it is more convenient to use exchange coefficients, but there are a number of practical problems which require knowledge of scattering factors. Here are presented averaged parameters of the reflected stream determined by means of solving the inverse problem by utilizing experimental and full-scale data from previous studies (1965-1979). The method of direct numerical simulation is employed for the purpose of calculating the aerodynamic characteristics of different bodies. The focus of the study is the study of the dependence of parameters of the reflected stream on the angle of incidence and their influence on overall aerodynamic characteristics. Special attention is devoted to the increase in the drag coefficient of bodies streamlined by a flow of heavily rarefied gas for the majority of sections of whose surface the local angle of attack is small. By modeling part of the particles reflected toward the oncoming stream it is possible to attempt to explain the considerable overestimate of the drag coefficient for narrow cones and pointed plates parallel to the stream. The results of numerical simulation were utilized for the purpose of solving the inverse problem of determining the parameters of the reflected stream. A table is given of averaged values of these parameters as a function of the angle of incidence. These include the coefficients of the normal and tangential components of the momentum acting on a unit area, the ratio of the mean value of the momentum of reflected particles in the direction of travel to the corresponding value for incident molecules, and the energy exchange factor. The table demonstrates that the characteristic curve for reflection in the plane of incidence can have three lobes: For angles of incidence of $0 \leq \theta_1 \leq 40^o$, reflection chiefly corresponds

to a Maxwell function with regard to velocities versus the temperature of the wall
and to the existence of a small number of particles reflected in mirror-image
fashion. With an increase in the angle of incidence the reflection corresponds
more to the quasi-mirror-image type and for angles of incidence of $80^{\circ} \leq \theta_1 \leq 87.5^{\circ}$
back reflection is observed. A table is given of the results of calculations of
the drag coefficient for spacecraft performed for different patterns of interaction.
Calculated data are given on the drag coefficient for six different shapes of
spacecraft. In these calculations the Mach number equals 12, the temperature of
the oncoming stream 1300 $^{\circ}$K and the temperature of the surface 300 $^{\circ}$K. Drag
coefficients are given for the following spacecraft: the "Cosmos-25," "-319,"
"-357," "-393," "-166," "-230," "-97," "-196," "Intercosmos-1" and "Intercosmos-4"
and an Apollo-type spacecraft and a hypothetical orbiting spacecraft. Calculations
were performed for lobe-type and diffuse interaction models, taking into account
the thermodynamic velocities of molecules of the oncoming stream. Analysis of
the calculations demonstrated that the drag coefficient is minimal for various
designs of compact spacecraft, such as the "Cosmos-25," "-319," "-357" and
"-393." In a previous study (1975) a mathematical expectation of the drag coef-
ficient of 1.981 was obtained for satellites of the "Cosmos" series, whose shape
is close to spherical. The calculated value obtained here of 1.9626 agrees well
with the experimental value, even though the reflection parameters were obtained
for bodies whose shape differs from spherical. An equation is given for the drag
coefficient for the case when it is necessary to determine it by taking into
account collisions between particles reflected from the surface and particles of
the oncoming stream. The author is inclined to believe that the value of the
drag coefficient for a spherical satellite, at least for low altitudes, is lower
than the traditionally accepted value of 2.1 to 2.2 for a diffuse pattern of
interaction and lies within the range of $1.8 < C_x \leq 2$, where C_x is the drag
coefficient. Figures 2; references 11: 10 Russian, 1 Western.
[360-8831]

'DIFFUSION' TECHNOLOGICAL EXPERIMENT ON THE 'SALYUT-5' ORBITAL STATION

AVDUYEVSKIY, V. S., GRISHIN, S. D., KRIVANDINA, Ye. A., LESKOV, L. V.,
MUKHOYAN, M. Z., POLEZHAYEV, V. I., SAVICHEV, V. V. and KHAIMOV-MAL'KOV, V. Ya.

[Abstract] A description and the results are given of the "Diffusion" experiment
conducted on the "Salyut-5" orbiting station for the purpose of obtaining data
on the features of mass transfer, of diffusion, in particular, under conditions
of weightlessness and for developing the theoretical fundamentals for industrial
production in space. Unlike the M-558 experiment conducted on Skylab, the diffusion
experiment conducted on "Salyut-5" concerned the process of the interdiffusion
of two melts of organic substances, i.e., dibenzyl and $C_{14}H_{10}$. The purpose of the
experiment was to make a study of interdiffusion, to determine the value of
diffusion coefficients under conditions on earth and in orbit and to compare

the results obtained with the data of numerical simulation. The "Diffusion"
instrument is in the form of an electrical heater in the shape of a cylinder
21 mm in diameter and 148 mm long. An electric heater is placed inside some
heat-insulation material which is encased in a thin layer of stainless steel.
Inside the electric heater are placed two quartz cells with the materials to be
studied and a copper container creating uniform distribution of temperature
inside the quartz cells. The unit is covered with a lid made of heat-insulation
material. The cells are completely sealed. In each cell one quarter of its length
(60 mm) was occupied by $C_{14}H_{10}$, and three quarters by dibenzyl, with weights of
0.09 g and 0.27 g, respectively. The free gas space in the cell did not exceed
one fifth of its length. Approximately 1 mg of finely divided SiO_2 powder was
added to both melts to serve as a source of crystallization centers when the melts
cooled. The diffusion experiment was carried out in February 1977 by cosmonauts
V. V. Gorbatko and Yu. N. Glazkov. The melts were heated for 72 h. The axis of
the unit was installed parallel to the direction of flight. The unit was opened
after it was delivered to earth. There bulk solidification was carried out and
polycrystalline bars were produced. The specimens were cut into four equal parts
and a determination was made of the amount of diffused matter in each of four
layers. Optical absorption analysis was employed for the purpose of determining
the content of the $C_{14}H_{10}$ impurity in the dibenzyl. The mixture of $C_{14}H_{10}$ and
dibenzyl was dissolved in toluene. The calculated value based on the measure-
ments made of the diffusion coefficient equaled $(7.9 \pm 1.5) \cdot 10^{-6}$ cm^2/s. Experiments
on interdiffusion were also conducted on earth with the same equipment under the
same conditions and several different methods of determining the diffusion coef-
ficient were used. The results obtained for the diffusion coefficient agreed
well with those obtained in the experiment conducted on "Salyut-5." The spread
in the results obtained was about 20 percent. The conclusion was therefore drawn
that the process of mass transfer in the "Diffusion" experiment was of a diffusion
nature. Figures 3; references 6: 4 Russian, 2 Western.
[360-8831]

OPERATIONAL PLANNING OF SCIENTIFIC EXPERIMENTS PERFORMED ON A SPACESHIP

BELYAYEV, M. Yu.

[Abstract] Since the detailed implementation of scientific experiments on board
a spacecraft is influenced by a number of factors having nothing to do with
the experiments themselves, operational planning is required as a follow-up to
the basic program. In addition, information received during the actual experiment
can affect its further course. The author discusses techniques for use in the
operational planning of scientific experiments, using astronomical observations
as an example. The factors that are taken into consideration are duration of
the experiment, spacecraft fuel consumption during the experiment, and the utiliza-
tion of equipment with a limited use time (such as gyroscopes) that is needed for
the experiment. Figures 2; references 7.
[317-11746]

OBSERVATIONS OF SPACE RADIO BEACONS USING RADIO INTERFEROMETERS WITH SUPERLONG BASES

GUBANOV, V. S., UMARBAYEVA, N. D., FRIDMAN, P. A., and YAGUDIN, L. I.

[Abstract] The use of radio interferometers with a superlong base (RISLB) for observing radio beacons in space can be extremely effective in solving a number of problems in geodesy, geodynamics, celestial mechanics and astronavigation with a high accuracy level as well as in comparing widely spaced time scales. Differential RISLB observations of radio beacons relative to quasars can be of great importance in fundamental astrometry because within the framework of one and the same measurement method (RISLB) they make it possible to use both geometric and dynamic methods to establish an inertial radioastronomical coordinate system as well as to determine its relationship to the fundamental coordinate systems of stars. Only with the mastery of RISLB observations of radio beacons is the possibility of using small antennas and the employment of amplified registry instruments, already in standard production. This circumstance affords a possibility for rapid introduction of the RISLB method into the practice of geodetic and geodynamic measurements. RISLB systems can be used in the observation of radio beacons in near-earth space in combination with their laser ranging because this will make it possible to solve a fundamentally new problem: determination of the instantaneous three-dimensional coordinates of space objects. The use of such a combined method of measurements for study of lunar motion and rotation is particularly timely. The method can be applied in the reasonably near future for observing artificial space radio sources (radio beacons) on artificial earth satellites, the moon and other bodies in the solar system. The authors here present a theoretical study of the possibilities for the development of work in this direction. Such observations, modeled on a computer, are described. The techniques for such measurements are discussed and the accuracy of measurements of the interference frequency and time delay is evaluated. Figures 5, tables 1; references 19: 11 Russian, 8 Western.
[13-5303]

EFFECTIVENESS OF USING AN AERIAL SURVEY IN THE INFRARED SPECTRAL REGION

YEGOROVA, O. I., Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] The advantages of aerial surveys in the infrared spectral region are discussed. Infrared rays during passage through the air are attenuated to a lesser degree than visible rays; a terrain survey can be made around-the-clock or throughout the year in the presence of clouds, using the windows of atmospheric transparency. In this article the author evaluates the effectiveness of use of an IR survey made by the line scanning method at a real time scale in comparison with a traditional aerial survey. A formula is derived which can be used in computing the probability of collecting terrain information. A table gives the probabilities of successful implementation of a survey in dependence on meteorological conditions and time of day for both IR and standard aerial survey methods. The data reveal that for a terrain survey for the purposes of compiling or revising special or small-scale topographic maps in the shortest time possible a preference must be given to an IR survey. The dependence of an aerial survey on meteorological conditions and time of day is considerable, which reduces the reliability of making a survey at a stipulated time, and sometimes make it impossible. The analysis makes clear that an aerial survey in the IR region is more effective than a traditional aerial survey at stipulated time intervals. Both in the USSR and abroad it has been found that an IR survey is particularly effective in discriminating features which are heated by internal sources (craters of active volcanoes, lava flows, forest fires, etc.). An IR survey is effective in discriminating and checking the good operating order of communication lines, moistened and frozen ground, fresh springs at the bottom of salt water bodies, areas of damaged crops, etc. Figures 1, tables 2; references: 2 Russian.
[14-5303]

RESULTS OF COMPREHENSIVE PROCESSING OF SURVEY MATERIALS FROM THE MANNED 'SALYUT' ORBITAL STATIONS

BOL'SHAKOV, V. D., LAVROVA, N. P., KRASNOPEVTSEVA, B. V., NIKOLAYEVA, Ye. M. and USOVA, V. V., Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] Specialists at the Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers have developed a method making it possible to plot a grid of parallels and meridians on space photographs on the basis of spacecraft trajectory parameters. An example of such a geographic tie-in of a photo-image to the earth's surface is illustrated in Fig 1. Fig 2 illustrates the results of study of the river and lake network in Kazakhstan on the basis of space photography.

A comparison of this figure with earlier published maps indicated that a number of rivers and lakes are missing on the latter. Space photointerpretation makes possible an objective evaluation of the correctness of cartographic generalization. Fig 3 is an example of the results of investigation of the dynamics of shorelines of lakes. A comparison of data from a 1971 space photograph and maps published in 1970 and 1975 revealed that the area and shoreline of Lake Zaysan were not in agreement. Fig 4 shows the results of a space survey of the Lake Aral region, which continues in a state of active regression, the area continuing to decrease. Comparison of space photographs of 1976 revealed considerable changes from the area as mapped in 1964 and 1970. Fig 5 shows the photodata taken from a space photograph of the agriculturally most favorable part of the western Tien Shan foothills. The space photointerpretation made it possible to study both the nature of relief of the sloping plains and the general characteristics of geological structure of this region. Fig 6 shows the information obtained from a space photograph for the northwestern part of the Fergana intermont basin and its mountainous borderlands, yielding much geomorphological information useful for further investigations of local structures promising for petroleum and gas (Fig 7). These are but a few of the examples of information obtained from space from the manned orbital stations of the "Salyut" type which will make it possible to solve problems in theoretical and practical geology, geography and cartography. Figures 7.
[14-5303]

SLIT PHOTORECTIFIER FOR RECTIFYING RADAR PHOTOGRAPHS

PAVLOV, I. M. and IONOCHEV, M. M., Novosibirsk Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] In 1975 specialists in the Photogrammetry Department at the Novosibirsk Institute of Geodetic, Aerial Mapping and Cartographic Engineers developed a slit rectifier for processing reconnaissance radar images. Using the slit rectifier the slant ranges are rectified into horizontal distances with the elimination of distortions introduced by the drift angle of the carrier and the nonsynchronicity of the rates of motion of the photographic material in the recorder and the ground speed of the carrier. This article examines the principal sources of errors arising in the formation of the radar image from side-looking apparatus with an antenna mounted along the fuselage. The principal characteristics of the slit rectifier are described. Some of the technical specifications are as follows: focal length of objective -- 100 mm; relative aperture -- 1:10; depth of focus -- +5 mm; measurements -- 910 x 550 x 640 mm; mass -- 35 kg; supply voltage -- 220 V; required power -- 90 W. The slit photorectifier is in successful use at the Arctic and Antarctic Scientific Research Institute. Radar photographs of a number of ice polygons have been processed. An evaluation of the accuracy of the radar photoplane indicated that the mean square error in rectification and compilation of the photoplane is 0.5 mm at the scale of the plan. Figures 5; references: 7 Russian.
[14-5303]

ON THE UTILIZATION OF HYDROGEOLOGICAL AND ENGINEERING GEOLOGY SPACE PHOTOGRAPHIC
MAPS IN REGIONAL STUDIES

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geology and Engineering Geology, and ROGOVSKAYA, N. V., Institute of Water Problems
of the USSR Academy of Sciences

[Abstract] Fragments of engineering geology surveys of the western area of the
Turan platform, compiled from space photographs, are used to illustrate the tech-
nique of interpretation which makes it possible to ascertain the spatial features
of the major engineering geological formations of rock and the role of disjunctive
tectonics in the development of a number of exogenic geological processes and to
more precisely specify the engineering geological regional breakdown. The hydro-
geological and engineering maps derived from space photography are of an inter-
mediate scale (more than 1:1,000,000) and represent the mapping of the results
of interpretation of one or more parameters, such as the degree of water infil-
tration of fractures, the types of aeration regions according to hydrodynamic
moisture transfer conditions, exogenic processes, etc. These materials were used
to determine the most promising regions for intermediate scale studies of such
processes as salinization of soils, the intensification of which in the northern
and southwestern regions of Ustyurt is due to the overflow via barrier faults of
saline underground waters from chalk deposits into the overlying water bearing
strata. Detailed photo interpretation maps are shown for the Turan platform
indicating such features as Upper Miocene carbonate rock, sea transgressions
from the Aral and Caspian seas, fissured areas above regional bedrock fractures.
A fragment of a special hydrogeological map of the western Turan region is also
shown indicating the age and genesis of water enclosing rock masses, hydrodynamic
elements and occurrence (i.e. depth and degree of mineralization and salinization),
as well as the conditions governing the formation of ground waters. The following
are recommended for the most effective utilization of space photographs in such
mapping: 1. The implementation of such mapping as a new kind of regional research
tool, providing for regional planning and targeted performance of surveys; 2. The
application o space photograph interpretation in conjunction with other procedures
for small and intermediate scale photographs; 3. The utilization of space photography
in survey and topical hydrogeological and engineering geological research for
additional study of territories previous photographed and the revision of existing
maps. Figures 3; references: 7 Russian.
[6-8225]

PROCESSING SATELLITE DATA FOR THE DETERMINATION OF THE COORDINATES OF A MOVING STATION

FIRSOV, Yu. G. and YAROVOY, B. D.

[Abstract] The authors discuss the use of satellite navigation systems to determine the coordinates of a moving ship by the integral Doppler method. The most widely used model for this involves equalizing the measurements relative to three un-knowns: the base frequency and the two geocentric coordinates. A system of n-parametric correction-factor equations is solved by the method of least squares, which makes it possible to determine the most probable coordinates at the final moment of an integration interval. The accuracy of the determination depends basically on the accuracy with which systematic errors are eliminated from the elements of the computation, and the authors point out that most other investigators do not take this into consideration. They also use the results of their research to formulate an improved algorithm for processing data from satellite navigation systems for the purpose of determining a moving ship's coordinates. Figures 7; references 4.
[4-11746]

INVESTIGATION OF INFORMATION VALUE OF OBLIQUE SATELLITE PHOTOGRAPHY OF WATER SURFACE

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[Abstract] Materials of satellite photographic surveys of the ocean surface are being utilized at present for geologic and morphodynamic studies of coastal waters, investigation of the pollution of water basins and for the study of biological productiveness and dynamics of ocean waters. The optical density of a photo-image, which reproduces the field of brightness of the water surface being surveyed, is the information carrier of processes occurring on the ocean surface and inside the ocean waters during their photography. From the optical density of photoimages, with allowance made for distortions caused by the atmosphere, photographic equip-ment and chemicophotographic processes, we can estimate the overall brightness coefficient of the water surface, whose value depends on conditions of illumination, composition of impurities in sea water and conditions of surveying. In selecting conditions of photographing the sea surface and to enhance effectiveness of satellite photography it is essential that the photos represent the maximum of information

about processes occurring in the near-surface layers. The authors analyze a series
of the successive overlapping photos of the sea surface taken from the "Salyut"
orbiting station with a wide-angle camera under different angles and discuss depen-
dence of their information content on orientation of the projecting beams toward
the sun. The photography was performed in accordance with the following constant
parameters: orbit inclination 51.6°; inclination angle of optical axis of camera
in relation to direction of the true vertical $\xi = 55^\circ$; solar altitude h. = 32.5°;
solar azimuth A. - 85°. Changes in reflectance of the sea surface were illustrated
by the results of microphotometering the same profile according to the negatives
of two photographs obtained at 42 sec interval. From the positives the areal
photometry of the sea surface of the sector under investigation was performed.
Results of photometry were presented in the form of histograms and from a comparison
of histograms peaks of the density distribution were determined. Compared to the
vertical photography the oblique photography makes it possible to widen the scope
of angles being formed by the projecting beams with the direction of true vertical
of the object and to obtain thereby a higher amount of information about the object.
Distortions caused by direct solar reflection from the sea surface were also
studied and it was found that they can be decreased by a chemicophotographic
processing without impairing the overall brightness interval of the object
being surveyed. Figures 3, table 1.
[324-1015]

ALLOWANCE FOR INFLUENCE OF SURFACE FACTORS ON A PETROLEUM AND GAS SEARCH SIGNAL IN A REMOTE THERMAL SURVEY

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[Abstract] Over petroleum and gas deposits there are anomalous increases in
the heat flow caused by the processes of oxidation, destruction and redistribution
of the heat flow due to natural convection in the deposit and due to oxidation
of gaseous hydrocarbons in the rocks covering the deposit. This increase in the
heat flow, in turn, results in an increase in the thermodynamic and r iation
temperatures of the earth's surface over the deposit; this can be registered when
making a remote thermal survey and thus is a search criterion for petroleum or
gas. Under real conditions the nonuniformity of the surface with respect to
reflective properties (albedo, relative radiation coefficient, degree of roughness,
vegetation cover, humidity, etc.) results in different heat transfer conditions
for different surface elements and causes differences in radiation temperatures,
which interfere in determining the useful search signal. This interference must
be taken into account in the processing (interpretation) of thermograms of remote
and thermal surveys. Taking this into account, the author proposes an interpretation
program. The first step is the discrimination of sectors with uniform surface
and smoothing of the radiation temperature curves within these sectors. The second
step is a first-approxiamtion elimination of the distorting influence of the
totality of exogenous factors caused by the type of surface on the geothermal
search signal. The third step is the exclusion of uninformative portions of the

thermograms caused by the coincidence of the survey line and different kinds of objects screening the search signal and extrapolation of the pattern of change of radiation temperature of the studied regions to adjacent sectors for which no information is available. The method described was used in the processing of data from a remote thermal survey in the Dnepr-Donets depression in a search for petroleum and gas. Figures 1; references: 4 Russian.
[333-5303]

ON THE GEOLOGICAL NATURE OF THE PHOTOBACKGROUND IN PHOTOGRAPHS TAKEN FROM SPACE

ROZANOV, L. N., All-Union Petroleum Scientific Research Institute of Geological Exploration, Leningrad

[Abstract] Space photographs provide information about the earth's geological structure in two categories: generalization of the objects observed and the "X-raying" effect for deep structures. The latter is called the "X-ray nature" of the image in a space photograph. For some reason that is not yet clear, deep structures show up on space photographs as a lightening or darkening of the background. Tectonic uplifts and depressions are reflected by increases and decreases in the density of the background: the higher the uplift, the darker and denser the background; the thicker the Quaternary or other younger deposits, the lighter it is. The author discusses his and other investigators' hypotheses concerning the reasons for this phenomenon. References 17.
[7-11746]

ACCURACY IN POSITION DETERMINATION USING THE 'TRANSIT' NAVIGATION SYSTEM

ABRAMOV, B. I. and IONOV, Yu. A.

[Abstract] During 1977, while carrying out investigations of the world ocean on the research vessel "Professor Zubov," operating under the POLEKSYUG program, specialists calculated the ship's coordinates using the "Transit" satellite navigation system (SNS). In this article the authors first analyze the different errors in these specific calculations, such as error in satellite position, error in computing the ship's position relative to the satellite and error in determining ship's speed during the observation period. A formula is derived for computing the total mean square error in determining the ship's position. This error is as great as 235 m, which shows that the system has no equal with respect to determination of position of a ship at sea. The merits of the SNS include: globality of its use, that is, the possibility of determining position at any point in the ocean; nondependence of coordinate determination on time of day and weather conditions; automation of computations; simplicity of form of data output and possibility of its storage; high accuracy in determining the ship's position. The shortcomings of the SNS include: complexity and high cost of the reception system; frequent instrumental malfunctions during work in the tropical zone and difficulty in eliminating them; considerably varying discreteness of observations, the average time between observations being 106 minutes, but in actuality varying from 4 minutes to 4 or 5 hours; prolonged duration of communication session (16-18 minutes); noncorrespondence of the 'Transit' SNS coordinate system to the coordinate systems in which sea charts are published. Figures 1; tables 2; references 6: 4 Russian, 2 Western.
[323-5303]

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